

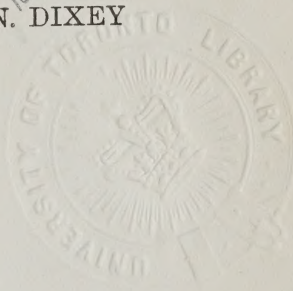


3 1761 06239777 3

ic.
ops

SUGAR BEET IN FRANCE, BELGIUM, HOLLAND AND GERMANY

schibald
BY
ager nicholas
A. BRIDGES AND R. N. DIXEY

A circular library stamp from the University of Toronto. The text "UNIVERSITY OF TORONTO LIBRARY" is arranged in a circle around a central emblem. The emblem features a shield with a cross and other heraldic elements, surrounded by rays of light.

R31709
24.4.R9.

OXFORD
AT THE CLARENDON PRESS
1928

OXFORD UNIVERSITY
PRESS

LONDON : AMEN HOUSE, E.C. 4
EDINBURGH GLASGOW LEIPZIG
COPENHAGEN NEW YORK TORONTO
MELBOURNE CAPETOWN BOMBAY
CALCUTTA MADRAS SHANGHAI

HUMPHREY MILFORD
PUBLISHER TO THE
UNIVERSITY



Printed in Great Britain

ACKNOWLEDGEMENTS

THE writers wish to place on record their appreciation of the valuable assistance which they received while in the countries mentioned in this report. Particularly they would like to acknowledge the help of the Ministries of Agriculture of all four countries, the Verein der Deutschen Zucker-Industrie, Berlin, the Comité Central des Fabricants de Sucre de France, Paris, and of M. le Sénateur Beauduin, Brussels, through whom they also received many introductions to persons in a position to give reliable information in regard to the sugar beet industry.

Thanks are also due to the Agricultural Departments of Halle and Göttingen Universities, to Drs. Fensch and Lothar Meyer, Berlin, and to Professor E. Saillard, Paris; to the Agricultural Advisors of the provinces of Friesland, Overijssel and North Brabant in Holland, to the Agronomes de l'État of Gembloux, Charleroi and Tournai in Belgium, and to the Directors of various factories, from all of whom they received much valuable material for this report.

It is also with great pleasure that the writers record their grateful thanks to many private firms and individuals for information and advice. In this respect they would especially mention the Messrs. Hörning of Rossleben, Germany, and M. Séblin, Montescourt, Aisne, France, M. Simonsen, of Brussels, M. Jules Dubois, of Gembloux, and Mr. Van Vloten of Goes, Holland. Many farmers, too numerous to mention individually, also helped materially in providing information for the report.

Messrs. Paul Parey, Berlin, are thanked for permission to use extracts from published German works.

Mr. D. Skilbeck, of the Agricultural Economic Research Institute, assisted with the preparation of the diagrams.

CONTENTS

I. INTRODUCTION	1
The districts studied—soils—size of holdings—rotations and cropping—livestock—labour.	
II. SEED	8
III. MANURING	18
Farmyard manure and green manure—artificial manures.	
IV. SOWING AND SUMMER CULTIVATIONS	25
Drilling—cultivations between drilling and the appear- ance of the plants—operations after the plants are up.	
V. HARVESTING	35
Date of lifting—methods of harvesting—hand-spudding —machine lifting—topping—collecting into heaps.	
VI. YIELDS	48
Roots—sugar content.	
VII. BY-PRODUCTS	65
Tops and leaves—pulp.	
VIII. COSTS AND RETURNS	78
Labour—manures—value of land, &c.—other expenses— general remarks on costs—returns.	
IX. TRANSPORT	88
Distance from farm to factory receiving points—al- ternative methods of transport—method of payment.	
X. RECEPTION OF BEET AT FACTORIES	94
Sampling—determination of weight—determination of sugar content—unloading at the factory.	
XI. PRICE-FIXING	98
XII. THE EFFECT OF SUGAR BEET ON AGRICUL- TURE	106
XIII. CONCLUDING STATEMENT	109
APPENDIX	110
I. Contracts	110
II. List of References	119



Digitized by the Internet Archive
in 2025 with funding from
University of Toronto

<https://archive.org/details/31761062397773>

LIST OF PLATES

Gang of imported workers hoeing beets in Germany	<i>facing p.</i>	6
Building used for housing gang labour in Belgium	.	6
Beets before singling, showing width of drilling, 15·7 inches—Holland, North Brabant	.	32
Horse-hoeing beets with four-row machine in France	.	32
Bunching in France	.	33
Singling in France	.	33
A common type of horse-drawn lifting machine in France		40
A typical German wagon	.	48
A typical French wagon	.	48
Two common types of pit silos	.	49

LIST OF TEXT-FIGURES

1. Map of Sugar Beet Acreage in parts of Europe. Each dot represents 1,000 acres. Reproduced by per- mission from <i>Geography of the World's Agriculture</i> , Finch and Baker, U.S.D.A., 1917	.	<i>page</i>	viii
2. Types of Spud	.		38
3. Prong for lifting Beet	.		39
4. Showing how Beet are laid in rows	.		42
5. Various types of implements used for topping by hand			43
Table XXIV	.	<i>To face p.</i>	78



Fig. 1. Map of Sugar Beet Acreage in parts of Europe. Each dot represents 1,000 acres.

I. INTRODUCTION

THE following account of the sugar beet crop in France, Belgium, Holland and Germany is the result of three short visits paid by the writers to the principal beet-growing districts in those countries in the years 1926 and 1927.

The general distribution of the crop is indicated by the map shown opposite.

It is seen that although the crop is to be met with in many districts, it is mainly concentrated in certain clearly defined areas, the most important of which occurs in the north-east of France and the south-west of Belgium. The French part of this region lies mainly in the departments of Aisne, Nord, Oise, Pas-de-Calais, Seine-et-Marne and Somme, where about 80 per cent. of the beets grown in France are cultivated, and where under normal conditions the proportion of arable land devoted to this crop amounts to about 8 per cent. This same beet-growing zone extends into Belgium, where, with the exception of the provinces of Antwerp and Luxemburg, the crop occupies some 5 or 6 per cent. of the arable land, reaching its greatest importance in Hainaut with 10 per cent., and rising to 15 or 20 per cent. in the western part of this province. In Holland the crop reaches its greatest concentration in Zeeland and on the adjacent mainland, where it occupies some 14 per cent. of the arable land, reaching its maximum of no less than 22 per cent. in Zeeland itself. In Germany the most important region lies in the middle of the country around the Harz Mountains, and extends from them for about 100 miles in an easterly and north-easterly direction, being mainly included in the Saxon province of Prussia. Here the crop occupies some 9 or 10 per cent. of the arable area. Of secondary importance is Silesia (SE. Germany) where about 4 per cent. of the arable land is devoted to the crop, whilst there are further concentrations in Mecklenburg (N. Germany) and in the Rhineland around Cologne (W. Germany). All these districts are predominantly arable.

Soils

Right through the middle of the French zone there runs from north-west to south-east a wide belt of soils derived from the chalk and flanked on either side by tertiary formations. In Aisne the soil is described as being very suitable for

beet cultivation owing to its fertility, to its lime content and to its being of the right consistency, and the same would apply in Somme. In the more northerly region, on the other hand, the soil is variable, though mainly of a heavy character, and it is on this soil, which is heavy though friable, that the best beet are grown. Across the border, in Belgium, the soils utilized for beet are also clay, and rather stiff to work, and it is recognized that these give the best results, though northwards in Flanders sandy soils are used to some extent.

In Holland the main beet-soil is sea-clay, on which nearly 80 per cent. of the beets are grown, though the crop is meeting with some success in sandy districts as a result of careful management and the application of suitable fertilizers.

In Germany the soils are various. The deep loams of the Harz Mountain district are agreed to be the most suitable, and it is here that beet-seed is mainly produced. South of the Harz the beet-land becomes heavier, whilst throughout the district attempts are being made to develop the growing of the crop on the lighter soils, though the shortage of lime and of moisture are sources of difficulty in this respect. Roemer¹ describes the best of these soils as having (1) the capacity to be worked easily and early, and to be easily penetrated by plant-roots; (2) very little tendency to crust; (3) good aeration in consequence of a good granulated structure; (4) a capacity to retain moisture, and (5) a very high content of nutritive material.

In each country the crop has been developed in the first place on deep clay soils, free from stones, and well supplied with lime and humus, and it is due to this high content of lime and humus that such soils are on the whole not difficult to work, since they break down readily under cultivation. Once the industry became established under such conditions, farmers within the sphere of influence of the industry have found it worth while to cultivate the crop on soils of less favourable kinds. In fact, wherever the crop is met with on soils other than the clay soils described above, it is probably because it has already been established on such a clay soil somewhere in the vicinity.

Clay soils which are cold and stiff to work, however, are not considered good, and sandy soils, although having definite advantages from the point of view of facility of

¹ For authorities mentioned throughout this report see list of references in Appendix II.

working, are not recommended. The disadvantages of unfavourable soils may nevertheless be discounted to some extent by suitable climatic conditions.

Size of Holdings

In all countries concerned there is a high proportion of small farms, considerably higher than in this country, but it is found that there is a strong admixture of large farms in the beet districts. In some of these districts the large farms predominate, in others large and small farms run side by side, whereas in others the land is held entirely by small peasant proprietors. Every farmer in fact within a beet-growing zone is found to cultivate the crop, regardless of the size of his holding.¹

Nevertheless, in districts of large-scale farming, it has been found necessary to build up systems for providing adequate casual labour to meet the special demands of this crop, and this would indicate that, although it is thus suited to large farms, provided such special facilities for additional labour of a skilled kind are available, yet it is a crop which naturally adjusts itself more readily to small-scale farming. Where large and small farms run side by side, the labour of the district is usually adequate without having to rely on help from outside, as the requirements of casual hands on the large farms can be met from the supply of surplus labour on the small holdings. Where large farms only are found, the casual labour must be imported.

Rotations and Cropping

On typical farms in the French and Belgian zone, straightforward three-, four-, or five-course rotations are usually

¹ The following figures, which show the acreage of beet grown for six factories, illustrate this point.

<i>Factory.</i>	<i>No. of growers.</i>	<i>Total acreage of beet.</i>	<i>Acres of beet per grower.</i>
No. 1 (Belgium) . .	2,670	4,026	1.50
No. 2 (France) . .	3,000	4,940	1.65
No. 3 (France) . .	8,300	19,760	2.38
No. 4 (France) . .	2,000	7,410	3.70
No. 5 (Holland) . .	1,070	9,880	9.23
No. 6 (Germany) . .	337	4,698	14.00

followed, the beet occupying from 25 to 40 per cent. of the arable area. Typical rotations of the main crops would be beet, wheat, oats; or beet, oats, wheat as a three-course; beet, corn, corn, forage as a four-course; and beet, wheat, oats, beet, barley with forage and potatoes as a five-course. In the latter case a variation might be beet, wheat, beet, oats, forage. In the three-course shifts it is customary to include on part of the break devoted to the second straw crop such subsidiary crops as flax, forage and potatoes, whilst in other rotations variations are made as necessary in order to introduce small acreages of the less important crops. In most cases the root break is entirely occupied by beet, but occasionally a small acreage of mangolds may be grown.

In Holland the cropping approaches that of typical fen districts, and is conspicuous for its complexity. The main crop in the north is potatoes, which may occupy some 25 to 30 per cent. of the ploughland, as against 12 to 16 per cent. under sugar beet. Wheat is the most important cereal, and other crops grown are beans, peas, flax and clover, with a very small proportion of mangolds and turnips.

In the more typically beet districts of the south, sugar beet may occupy about 25 per cent. of the area, whilst the potato acreage is reduced to nearer 5 per cent. Grain crops occupy some 30 per cent., and peas and caraway 9 per cent. each, while the remainder of the land is divided between poppy, mustard, flax, beans, mangolds and clover. On the light soils on which beet is grown a typical rotation would consist of a five-years' ley followed by beet, wheat, beet, legume, beet, wheat or oats.

In Germany the rotations become even more complex. Although they have been undoubtedly derived from the Norfolk four-course shift, they have been qualified as occasion demanded, until in many cases anything in the nature of a systematic rotation is unrecognizable. In a typical beet area, untroubled by disease, a simple rotation as regards main crops might be, beet, wheat, barley; or beet, barley, wheat, peas. Another rotation met with was beet, barley, peas, wheat, beet, oats, lucerne for several years, potatoes, while rotations up to 17 years are also adopted. The latter cases are mostly found in areas which have become so infected with disease that beet can only be grown at infrequent intervals. Potatoes then figure largely in the cropping.

Livestock

All forms of livestock husbandry are practised in the beet-growing districts. Although those which are particularly noticeable as being associated with sugar beet farming are dairying, cattle fattening and sheep rearing, it would seem that the crop is readily adaptable to whatever type of livestock and system of farming the requirements of the district demand. Draught oxen are frequently met with in Germany, France and Belgium, and on small-holdings mules and cows are not uncommon for purposes of haulage and cultivation. The growing of sugar beet, coupled as it is with liberal supplies of by-products in the form of fodder, while demanding plentiful dressings of farmyard manure, seems to go hand in hand with a heavy head of livestock.

Labour

Sugar beet, if grown to any large extent, exacts a severe toll on the labour strength of any agricultural district. Roemer in fact states that the extent to which beet can be cultivated is primarily determined by the labour available, and he gives the following figures as a comparison of the labour requirements of various crops over a period of 30 years.

TABLE I. *Average labour requirement of various crops, compared with that of wheat (taken as 100) (1984 to 1923)*

Sugar beet	375
Mangolds	342
Potatoes	311
Peas	155
Field beans	139
WHEAT	100
Barley	83
Fodder crops	69

According to these figures sugar beet utilizes labour, at any rate in Germany, to a considerably greater extent than any other general farm crop, exceeding even that of potatoes by 20 per cent., and it is probable that the same is true of other countries.

In Germany 350,000 foreign labourers used to be imported annually for the work on the sugar beet crop. This would represent approximately one immigrant per $3\frac{1}{4}$ acres of beet. The number has been reduced by about 60 per cent. in recent

years, owing to the desire of the Government to provide more work in the country for the home unemployed, but there is still an immigration of 100,000 to 150,000 foreigners (mostly young Czech and Polish women), or 1 per 7 acres of beet.

On a number of large farms where beet is grown, the casual labour has been found to amount to 32 per cent. of the total labour strength, as against 20 per cent. on similar farms where no beet is grown, and where beet is the outstanding feature of the farm, it may even amount to 44 per cent. (Roemer). So important is this feature of the industry, that in the absence of this supply of labour, so it was stated, a more extensive system of farming would have to be adopted on the large farms, where such crops as wheat, oats, barley, lucerne, and fallow would be grown to the exclusion of beet.

To alleviate the situation in the meantime the factories are stated to be looking to the small-holders to develop their beet-growing, since it is recognized that they are less dependent on outside labour for the work on the beet-crop than are the larger farmers. This, however, is not the only reason for the preference. The small-holder is always reckoned to cultivate his small plot of beet with the aid of his family, as if it were a garden crop, and thus to be able to produce higher yields and better quality roots.

Apart from the foreign labour it is customary in beet-growing districts for part of the school holidays to be fixed so as to allow the children to help with the singling. Moreover, in districts where large and small scale farming are found side by side, it is a common feature for the small-holders to hire themselves out to the larger farmers, either after harvesting their own small acreage, or leaving some members of their families to do the work while they are away. Assistance with the harvesting of the crop is also obtained where possible from industrial workers, who come on to the farms in their spare time.

In Belgium the gang labour consists mainly of Flemish workers, considerable numbers of whom are to be met with in many districts. The rate at which this labour is used is approximately 2 hands for each 10 to 12 acres of beet. These may be a man and a woman, or a man and a boy, or child. In Flanders where small-scale farming predominates, there is not sufficient scope in the immediate neighbourhood for the surplus labour, which therefore migrates in gangs to the districts where the farms are larger. In districts of mixed



GANG OF IMPORTED WOMEN WORKERS HOEING BEETS
Germany



BUILDING USED FOR HOUSING GANG LABOUR
Belgium

large and small farms, the small-holders work for their larger neighbours, just as they do under similar circumstances in Germany.

In Holland, on the other hand, gang labour is not much in evidence. The 'rush' period is dealt with by the families of the ordinary farm labourers, although there is a slight movement of casual labour from Brabant to Zeeland during the time of lifting.

There is a considerable influx of foreign labour to France for the beet crop, both of Poles and Flemish workers, but the local labour is usually preferred. In some areas, however, the supply of local labour is becoming less plentiful, and it was stated in one district that the proportion of the arable land devoted to beet has been reduced from a third to a sixth. This was considered to be due to the fact that many men have left the farms to join trades, in which the hours of work are fixed, and are much fewer than in agriculture.

The general procedure with regard to the gang labour is for agents to collect the gangs and to bring them at the beginning of summer into the districts where they may be wanted. The farmers usually deal direct with the agent, paying him the agreed rate of wages, and providing the lodgings. These lodgings take various forms, and consist at any rate on the larger farms of barracks, usually with dormitory accommodation and a room for cooking and feeding. In some places any available building is used, as for example, a barn, or a shed, such as is shown in the accompanying illustration. The gangs, under the supervision of gangers, work practically from dawn till dusk during the busy times, and remain on the farm until the harvesting is completed, when they return to their homes with the money they have earned.

II. SEED

THE success of the sugar beet industry on the Continent has been due in a large measure to the striking progress made during the last 50 years in the yielding capacity of the crop. While the improvements in the technique of cultivation and of manuring have had an appreciable influence in securing higher yields both of roots and of sugar, great credit is also due to the private firms engaged in the production of commercial sugar beet seed. All the leading firms maintain departments in which plant breeding specialists, by scientific methods of research, are engaged continually in an endeavour to secure improved strains.

The main principle followed in present day methods of commercial beet seed production on the Continent is that of continually selecting those roots which show the best performance on the trial grounds, and of using them as *mother-beets* for the production of strains or *families* of seed. Care is taken to observe not only the desirable properties of the selected roots, but also their ability to transmit these properties to their progeny.

In establishing such strains, the weight of roots, the sugar content and the purity of the juice play an important part, while other features, such as resistance to disease, tendency to 'bolt', the size and shape of the root and the quality of the leaves are also taken into account.

It is sometimes stated that British beet seed producers are labouring under a serious handicap, owing to the fact that the Continental breeders have a lead of half-a-century, and it may be convenient at this point to examine this contention.

The foreign breeder sows from his *stock seed* each year enough to produce seed for sale, as *commercial seed*, two generations later, meanwhile re-selecting his stock seed. Any one in a position to purchase stock seed would be starting from the same point as the foreign producer from whom he bought it, and, other things being equal, and assuming similar methods of selection, he should be able to keep pace with him. In point of fact, however, the seed available in this country is not stock seed, but commercial seed.

Nevertheless, it should be borne in mind that inasmuch as any given generation of commercial seed embodies the ancestral history of the stock from which it was immediately derived, its use as a fresh basis for selection will not be the same thing as the employment of seed whose ancestors have not been regularly selected. So far from starting at zero, it will already have proceeded far along the path of possible improvement. The extent of the gap to be bridged, in fact, is not half-a-century, but the time required, if necessary, to select the commercial seed until it regains the qualities possessed by its immediate ancestors. There is thus less importance to be attached to the alleged 'handicap' of English seedsmen (to whom the foreign commercial seed is accessible) than has often been supposed.

Moreover, in the experience of the writers no foreign beet seed firm (with the exception of one, and that but recently) has attempted to employ any method other than that which may be described as simple selection. Practically the whole field of possible improvement in beet seed by means of Mendelian selection remains to be explored. If, therefore, the British seed producer can adopt this method with the same success which has attended its application to other classes of seed (wheat, for example), there is no reason why he should not outstrip his Continental rivals, who, even if they also turn to that method, can only start from almost the same point.

The breeding of seed for commercial purposes has proceeded towards the production of three main types:

Type E. In which the special feature is great weight of roots per acre. (Quantity roots.)

Type N. In which satisfactory yields both of weight and of sugar content are obtained. (Middle Grades or Normal.)

Type Z. In which a high sugar content has been attained. (Quality roots.)

A fourth line has been developed and is known as ZZ or extra rich in sugar. As an example of the performances of these three main types in respect of weight, sugar content and sugar per acre, the following figures from recent experiments carried out by Professor Remy of Bonn are given:

TABLE II. *Comparing types of seed for yield.*

<i>Type.</i>	<i>Sugar content. Per cent.</i>	<i>Roots per acre. Tons.</i>	<i>Sugar per acre. Cwt.</i>
Quantity roots . .	16.3	14.22	46.3
Middle grade . .	17.0	13.86	47.1
Quality roots . .	17.5	13.19	46.1

So far as sugar content is concerned there is an increase in this case of 1 per cent. in favour of *quality* roots, while the *quantity* roots have an advantage of one ton as regards weight. Yield of sugar per acre is much the same with both these types, though the Middle Grade, or N types show an improvement in this respect. These N types are regarded as the most suitable for typical sugar beet land, where they are generally considered to give the best yields of roots with a high sugar content, and a resulting high yield of sugar per acre. They require an average period of growth.

The E types, in which the breeding has been biased towards a large weight of roots per acre, mature comparatively slowly and are suited to climates wherein the period of vegetation is long. They do not give their maximum yields unless harvested late, but as they are regarded as being suitable for light sandy soils, slopes of hills and warm dry soils, no serious increase in costs at harvest through unfavourable weather is likely to arise. They are not, however, the most economical beet from the factory standpoint. These types presuppose a large yield of roots with a sugar content below the average, and a yield of sugar per acre which is not often so high as can be obtained by the use of other types. For the factory, this means handling a very much larger tonnage of beet and by-products, and consequently increased costs of working.

So long as the farmer is paid primarily on a basis of tonnage, rather than on percentage of sugar, the output of roots becomes the deciding factor, the more so because his yield of by-products is thus correspondingly increased, and the E types are therefore more favourable to him. Their disadvantage lies in the increased cost of transport involved, a disadvantage whose importance grows with the distance of the farm from the factory. On the other hand, the production of beets rich in sugar, of a high purity, as in the Z types, is a very desirable feature of the seed breeder's business, since, provided high yields of roots can be secured, the amount of sugar per unit of area will be increased, and trans-

port costs and factory expenses per unit of sugar output will be correspondingly reduced. In the long run this should influence favourably the price paid to farmers for their beets. Unfortunately it appears that the Z types, while producing high sugar contents, do not give a sufficiently high yield of roots, so that from the standpoint of both farmer and factory they are at present less economical.

Z types, however, have other desirable characteristics. They are suitable for colder and humid climates, and for districts where the period of plant growth, for whatever reason, is short. They are earlier in maturing, and are therefore suitable for late planting, as well as in cases where maturity is likely to be delayed, or where harvesting conditions may be difficult. The Z types are also recommended for humus soils, where bulk of yield can usually be easily secured but where low sugar contents often occur, and, on account of their early maturity, for heavy soils.

Generally speaking, the N types are more popular. They effect a compromise between the interests of factories and farmers, and on all good soils and in favourable climates they are to be recommended. Extreme types (as E and Z) should only be used to compensate disadvantageous circumstances, or conditions giving rise to one-sided results as an effect either of climate, soil or cultural factors. On first class beet soils it appears that they will not usually give results so good as may be obtained with the N types.

In the absence of a home grown sugar beet seed industry careful choice of seed by the factories is highly desirable. The division between the seed types are quite arbitrary, and although seedsmen may label their samples as being of E, N, Z, or ZZ type, it does not follow that there will not be considerable variations in the performances of samples of the same type drawn from different sources. These variations are wide enough to cause the types to overlap in such a way that one seedsman's E type, for example, may well be equivalent to another's N type, and so on. It is only by dealing with firms of repute, therefore, whose strains of seeds are known to fall within the usual limits of the type to which they are assigned, that growers can be sure of obtaining the type they require. An example of the value of good seed is seen in the following table, which shows the results of an experiment of Remy's, in which he was testing the value of types for early and late harvesting:

TABLE III. *Special seed compared with common stock.*

<i>Brand.</i>	<i>Orig. Klein Wanzele- bener, Type E.</i>	<i>Common stock.</i>
<i>I. Early harvest (first half of October).</i>		
Roots per acre (tons) . . .	14.98	12.99
Sugar (per cent.) . . .	17.1	17.3
Sugar per acre (cwt.) . . .	51.24	42.74
<i>II. Late harvest (first half of November).</i>		
Roots per acre (tons) . . .	17.05	14.38
Sugar (per cent.) . . .	17.7	18.0
Sugar per acre (cwt.) . . .	60.37	51.78

Probable error + 0.358 tons $\pm$ 0.18 per cent. sugar content.

The advantages of obtaining good seed are thus well illustrated by the lowness of the yield from seed of common stock.

The exclusive use of native grown seed is not a usual occurrence in all the countries visited. Germany alone relies nearly entirely on home grown seed and it was difficult to find seed of other countries being used there except perhaps for experimental purposes. In Holland, although a considerable quantity of native seed is used, German seed was found in all the districts visited. In Belgium, imported seeds, from Germany and Holland in particular, were exclusively used, while in France a fair proportion of imported seed is grown.

German seed was particularly well spoken of in all countries, and of its high standard of excellence there can be little doubt. Dutch seed also has a good reputation. On the question of the supremacy of the German and Dutch seeds it should be remembered that the French sugar beet seed establishments suffered severely during the war, and have found it necessary in some cases to make a fresh start with imported strains. The firms in the war area, in fact, have only now been able to re-establish varieties of their own.

A recognized authority in Holland is of the opinion, derived from observations of experiments carried out in many countries, that the seed of any particular country usually gives the best results in that country. Indeed it is not unlikely that seed selected according to its performance under the climatic, geological and cultural conditions appertaining to the seed grounds of a particular country, will be better suited than will seed selected elsewhere for general

cultivation in that same country, where similar conditions will naturally prevail. ~~X~~None the less, it remains a fact that farmers in Holland use a quantity of imported seed, a condition which suggests that the view in question is not universally accepted.

Most of the seed on the Continent is supplied to the farmers through the factory companies. In the vicinity of Charleroi in Belgium, however, the farmers buy their own seed in the open market, and so exercise individual preferences in regard to different brands of seed. This feature was also found in one of the French Departments where one firm of seed merchants supplied seed direct to farmers, the factories allowing the latter to make their own choice. This practice, however, is sufficiently uncommon to be of no importance. A choice of seed is always given to farmers by the factory companies, and they will often meet the farmers' preferences for strains of seed which are not usually included among the standard varieties supplied, provided a decision is made before a certain date, after which one or more of the standard varieties will be given. In Holland the co-operative group give their growers a choice of four varieties, and the maximum number which came to the writers' notice was six, in the case of factories operating in the Namur province of Belgium. Besides arranging for the supply of seed to growers—in many cases free, and in most at cost price—factory companies were found, in Holland, which pickled with a suitable germicide all seed supplied by them, as a preventive against fungoid diseases. For the 1928 crop the co-operative group of factories in that country are arranging for all seed used by their growers to be treated at the Dintaloord factory in the Province of North Brabant. Owing to the uniformity of treatment which such central control makes possible, there appears to have been thus established a very useful service to growers.

As seed is cheap, or is supplied free of charge, very little attention is paid to effecting economies in the amount of seed used. Figures were collected from farmers and others, and they are shown in the following table, together with the drilling distances adopted: ~~X~~

TABLE IV. *Seed rate per acre.*

Country and district.		Distance between drills.	Amount of seed per acre.	Equivalent for drill widths of ¹	
				18 in.	20 in.
		<i>in.</i>	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
<i>Holland:</i>					
Friesland	1	13·8	14·1	10·8	9·7
"	2	13·8	14·1	10·8	9·7
Overijssel	3	17·3	15·8	15·2	13·7
Zeeland	4	15·7	15·4-13·2	13·5-11·5	12·1-10·4
North Brabant	5	15·7	13·4-10·5	11·7-9·2	10·5-8·3
"	6	13·8	22·0	16·7	15·1
<i>Germany:</i>					
Harz	1	15·7	35-26	29-22	26-20
"	2	17·0	35·0	33·0	30·0
"	3	15·0	32-26	27-21	24-20
"	4	17·0	35-26	33-24	30-22
"	5	19·7	23·0	25·0	23·0
General	6	17·2	26·4-22·0	21-17	19-16
<i>Belgium:</i>					
Namur	1	15·7	25·5	22·2	20·0
"	2	15·7	26·4 ²	23·1	20·8
"	3	{ 15·7 } 17·7	24·6-15·8	{ 21·5-13·8 } 24·2-15·5	19·4-12·4 21·3-14·0
Hainaut	4	15·7	26·4-22·0	23·1-19·3	20·8-17·3
"	5	15·7	26·4-22·0	23·1-19·3	20·8-17·3
<i>France:</i>					
Nord	1	{ 13·7 } 15·7	17·6-16·8	{ 13·4-12·8 } 15·4-14·6	12·1-11·5 13·8-13·2
"	2	17·7	22·0	21·6	19·5
Aisne	3	{ 16·7 } 17·5	22·0-17·6	{ 20·4-16·3 } 21·4-17·1	18·4-14·7 19·2-15·4
"	4	{ 15·7 } 16·5	22·0-20·0	{ 19·2-17·4 } 20·2-18·3	17·3-15·7 18·1-16·5

¹ Theoretically the same number of plants should be obtained per foot run with these rates of seeding as for narrower drilling. However, with wider drilling a failure of the plant in some of the rows would have a more detrimental influence than if the rows were closer. For this reason more seed would be necessary than stated, as an insurance against additional risk.

² Other farmers use 22 lb. but this farmer prefers to sow thickly to obtain a good plant.

In all countries considerable variations in the seed-rate were found, and, with the exception of Holland, the rate of sowing is generally higher than that advocated in this country. It will be noticed, however, that the width of drilling, while exceptionally variable, is generally narrow, and this in itself would necessitate the use of more seed per acre. In order to obtain comparability of the figures, the quantities of seed sown have been reduced to drill widths of 18 in. and 20 in. and the resulting figures are shown in the last two columns of the table. It will be seen that in Germany and Belgium, and to some extent in France, the amount of seed used is still on a higher level than that recommended in this country. In Germany the reasons advanced for this heavy seeding were (1) the large employment of casual labourers; (2) when the crop is bunched, either by hand or by machine, before singling, it is essential to have a regular plant; and (3) it was necessary to guard against the most adverse possible circumstances of soil and climate. The two latter reasons would equally apply to Holland, where, however, less seed is used.

It is true that in the beet growing districts of Belgium and France, as in Germany, much imported labour is used, and this would support the first of the reasons advanced for the heavier seeding. It may be that in Holland, which is a low lying country with an efficient drainage system, moisture conditions of the soil are generally good in the Spring, despite extremes of drought and rain, so that conditions more favourable to germination are secured. In Germany factories usually supply from 20–37lb. of seed an acre to their growers. Roemer strongly recommends 28 lb. an acre and prefers 32 lb. an acre, as any small additional expense for seed will be repaid at harvest. In his opinion average fields have up to 15 per cent. failures. Thick sowing diminishes this percentage and tends to prevent gaps, while it makes growth more prolific, thus reducing the losses from night frosts.

It will be noticed that on several of the farms enumerated in the table two rates of seeding are given. The higher rate is the amount used for the earliest sown batches, or when soil and climatic conditions may not be so favourable for germination. The amount by which the ordinary seed-rates are increased for such reasons is, on the average, 4·8 lb. an acre. The germinative capacity of the seed and the size of the individual capsules, both of which vary according to the

season, are also factors which are taken into account in determining the amount of seed sown.

The nature of soils also influenced the rate of seeding. In Holland the crop is being grown to some extent on light sandy soils, and it is even being extended to soils which would be regarded as blowing sands in this country. Farm 3 in Overijssel is on a very light soil of the blowing sand variety, and the soil on Farm 6 in North Brabant is also of a very light character, and it will be observed from the table that the amount of seed used on these farms is much higher than is used on the heavy soils of the other provinces. On the former farm it was stated that the amount used was nearly double that used elsewhere (i. e. on heavier soils). A high rate of seeding in these cases is essential to guard against drought. There is, in addition, a high mortality after the plants are through the ground, not owing to drought only but also to the nature of the soil, which in windy weather is blown about and smothers a good many of the young plants.

It is clear from these notes that there is no uniform rate of seeding which can be recommended to growers in this country. The variations between countries suggest that each country and even each district has its own optimum seed rate, which will be determined generally by climatic and soil conditions. Local experience must be relied upon to establish this point for the various districts in this country, and the factors previously mentioned must be carefully studied if successful stands are to be obtained. Outside the germinative capacity and size of the seed, conditions which influence the rate of seeding may be summarized as follows:

(1) *For a high seed-rate.*

Adverse soil and seed-bed conditions; early planting; light soils; deep planting; where crusting is anticipated; where casual labour is employed; where bunching before singling is practised; where mechanical bunching is carried out.

(2) *For a low seed-rate.*

Good seed-bed, late planting.

It is true that a high rate of seeding prevails on the Continent as a whole, and it is a practice which is favoured not only by those engaged in the industry, but also by such an undoubted authority as Roemer. It is probable, therefore,

that Continental growers would be ill-advised to be niggardly with seed. Nevertheless, there appears to be little scientific experimental data on the question, while the arguments adduced in favour of heavy seeding are based for the most part on no securer foundation than general opinion. To what extent these opinions are sound when applied to British conditions is a question which might well be scientifically investigated in this country.

III. MANURING

IN considering the question of manuring for beet on the Continent, no detailed statement as representing general conditions can be given. It is true that for each district, and within certain limits for each country, general rules of manuring obtain, but it is equally true that each district and each country can show many individual cases of wide deviations from typical manurial policy.

Farmyard Manure and Green Manure

Farmyard manure undoubtedly forms the basis of the manuring. Saillard has stated that numerous experiments have shown that the maximum production of sugar per acre cannot be obtained by the use of artificials alone, and it was found by the writers that the opinion of practical farmers in the countries visited would bear this out in most cases. The usual practice is to give farmyard manure to beet so far as possible, though in Holland the direct application of dung to beet is perhaps not so universal as in the other countries. So far as Germany is concerned, the only crop which competes with beet for the farmyard manure is potatoes, and the same on the whole is true of Holland, where, especially in Friesland, dung is often applied to the potato crop immediately preceding beet. In most cases where dung is used, the dressings are heavy (in Germany from 8 to 16 tons per acre, 10 or 12 tons being a common rate of application; in France dressings up to 18 tons are not uncommon; in Belgium 16 tons seems to be the usual quantity, though many farmers apply 12 to 14 tons, and in Holland anything up to 16 tons per acre), but in many of the main beet-growing districts a quarter or even a third of the ploughland may be under beet, and it is not to be expected that any but the larger farmers, whose resources are capable of maintaining a very heavy head of stock, can dress the whole of their beet break with dung every year. The deficiency is usually made up with green manure, either in addition to a reduced dressing of dung or without dung at all. Thus in parts of Saxony and in the Rhineland, where the normal dressing of farmyard manure is in the region of 12 tons per acre, this quantity may be reduced to 7 or 8 tons if green manure is to be applied in addition.

Although it is not common, a few cases were met with in

Belgium where beet is cultivated with green manure rather than with dung, the latter being applied to the cereals in the rotation, while cases are occasionally met with in all countries where beet is grown with neither farmyard nor green manure. The green manure usually takes the form of vetches, lupines, clover or trifolium, or of mixtures usually containing peas and beans, the choice depending on a variety of reasons. In Belgium, for example, it was found to be agreed on all hands that the land must be clean for beet. Lupines therefore, which would be sown in the previous crop, are only used where the land is already clean. If, on the other hand, the land on which it is proposed to grow the beet is foul, vetches are favoured, as this enables the land to be cleaned first, and, once the vetches are up, the weeds are smothered.

As an example of the use of green manure as a supplement to farmyard manure, a Rhineland practice may be cited. Here, after the removal of a corn crop (probably winter barley), 8 tons of farmyard manure per acre are ploughed in. Crimson clover is sown at once, and this is also ploughed in together with potash and superphosphates in due course.

Saillard points out that both these manures improve the physical condition of the soil, whether light or heavy, and that they often advance the date of sowing, especially if a sufficient dressing of lime is given from time to time.

Artificial Manures

The extent to which artificial manures are used depends mainly upon whether farmyard manure and green manure are also used. Differences of soil do not have so marked an effect in this respect, though the lighter soils on the whole receive more nitrogen and potash than the heavier. The use of potash varies more with the class of soil than is the case with other manures, and this is due, among other reasons, to the fact that it is inclined to make heavy land more stiff, a reason which also causes some farmers to prefer kainit to potash salts. In parts of Friesland, where the soil is heavy, potash is often considered unnecessary, and the same is true of parts of Germany, especially Hanover.

Nitrogen.

The noticeable feature of the manuring throughout is the relatively high rate of application of nitrogen. Artificial nitrogenous manures usually take the form of sulphate of

ammonia and nitrate of soda, though nitrate of lime and calcium cyanamide are also favoured, the latter especially in Germany. In that country it is very seldom that less than 2 cwt. of some nitrogenous manure is given per acre in addition to farmyard manure, and dressings of $3\frac{1}{2}$ to 4 cwt. are not uncommon. Where no organic manure is used, dressings of 4 or $4\frac{1}{2}$ cwt. are frequent. In Belgium the dressings are heavier. Sixteen cases provide exact information, and the average dressing on these farms is $4\frac{1}{2}$ cwt. per acre in addition to dung or green manure. Larger dressings than this are given in six cases, and one farmer actually applies 8 cwt. The smallest dressing is of 2.8 cwt. per acre in one case. In Holland the dressings range from $1\frac{1}{2}$ cwt. of sulphate of ammonia in a case where the beet follows potatoes heavily manured, up to $5\frac{1}{2}$ cwt. of nitrate of soda, where the beet is being grown on the very light sands in the district known as Veluwe, which lies to the East of the Zuider Zee. On the stiffer soils of Friesland, the dressings may be about 3 or 4 cwt., often given in two doses, one of sulphate, the other of nitrate, and a typical dressing on the sea-clay of Zeeland would be 4 cwt. of nitrate of soda. One experienced farm-manager in Holland claims that manurial trials have not yet proved the relative values of different fertilizers. His choice is therefore entirely dependent on price, with the result that his nitrogenous dressing at the present time is nitrate of lime. Pre-war experiments in France, however, indicate that nitrate of lime may give better results than nitrate of soda as regards sugar content, but not always as regards yield. Saillard states that the richest beets from the point of view of sugar are those with the least soda in their ash content, and this would perhaps be one reason for preferring nitrate of lime.

The danger of applying nitrogen in excess, especially with sodium as a base, is that growth may be stimulated and prolonged to such an extent that the plants continue to grow after the time when they should normally be ripening off, and although a heavy weight of roots may then be harvested, their quality will be inferior from the point of view of sugar content. The Continental remedy for this defect is not to reduce the dose of nitrogenous fertiliser, a course which would lead to a reduced weight of crop, but to apply the full quantity as early as possible, so that the nitrogen may be fully utilized before the normal time for the plant to mature. The root then ripens in the ordinary way, and a maximum

quantity of sugar is obtained. Thus, calcium cyanamide is usually ploughed in with the farmyard manure in the autumn, and sulphate of ammonia and nitrate of soda are frequently given in February and March. Relatively small top-dressings of nitrate of soda may be given as late as singling-time, but it is unusual to find any application being made in normal seasons after the end of May.

That it is easy, even with a quick-acting manure such as nitrate of soda, to obtain adverse results by failing to apply nitrogen early, may be seen from the following record of an experiment conducted by Remy in the Rhine Valley:

TABLE V. *Effect of Date of applying Nitrogen*

		Yield per acre. Tons.	Sugar content. per cent.	Sugar. per acre. Cwt.
No nitrogen		16.8	17.7	58.4
2½ cwt. of nitrate of soda applied in 3 dressings.	<i>Early:</i>			
	Apr. 25, June 6, June 24	18.8	17.4	65.3
	<i>Medium early:</i>			
	June 6, June 24, July 7	18.6	17.2	64.0
	<i>Late :</i>			
	June 27, July 7, July 19	17.7	16.8	59.4

It is seen that the early dressings produced the highest yield of roots, the highest sugar content, and the greatest quantity of sugar per acre, and if this be true of nitrate of soda, even greater importance must attach to the early application of the slower-acting nitrogenous compounds.

An experienced grower in Saxony meets the difficulty by applying 3 cwt. per acre of calcium cyanamide in winter. This is followed in spring with 1½ cwt. of nitrate of soda applied never later than the beginning of May. The nitrate is applied along the rows, in a single dressing to avoid expense, and is worked in by hand-hoe to reduce loss.

Phosphates.

Superphosphate of lime is the popular phosphatic manure, and is used in most cases. In Germany the dressing varies from 2 to 4 cwt. per acre, when used in conjunction with

farmyard manure, and this may be increased to $4\frac{1}{2}$ cwt. where dung is not used, or where green manuring only is adopted. In Holland and France the dressings are inclined to be slightly heavier, ranging in the cases under review from 3 to $5\frac{1}{2}$ cwt. of superphosphate or its equivalent, according to the amount of farmyard manure given, whilst in Belgium the average dressing is a good deal heavier, being as much as 7 cwt. per acre in addition to dung.

Potash.

Potassic fertilizers vary more than do the other manures both as regards the kind used and as regards quantities applied. In Germany and Zeeland the most general form is 40 per cent. potash salts, whilst in France and Belgium kainit is usually employed, though muriate of potash and sylvinite are also used to a considerable extent. In Friesland, as in other regions of heavier soils, the use of potash is often considered unnecessary, especially if the beet crop follows a temporary ley, as is sometimes the custom in the north of Holland.

So far as quantities are concerned, the dressings range in Germany from 1 to 4 cwt. per acre of 40 per cent. potash salts, the normal rates being $1\frac{1}{2}$ to 2 cwt. when farmyard manure is used, and up to 3 or 4 cwt. when organic manures are reduced or absent. In Zeeland 2 cwt. of 40 per cent. potash salts are usual, though as much as 5 cwt. may be required on the very light sands of Overijssel. The customary dressing in Belgium is about $4\frac{1}{2}$ cwt. per acre of kainit (or, in some cases, of sylvinite), or $1\frac{1}{2}$ to $2\frac{1}{2}$ cwt. of muriate of potash, while in France the practice is similar.

Compound Manures.

It is very seldom that these are employed.

Lime.

Lime in one form or another is applied freely in all countries, especially on heavy soils. In many cases the land is limed once during the rotation, but the lime is not always applied to the beet crop direct. In Germany the dressing varies from 1 to 2 tons per acre of quick-lime every 6 or 9 years, the frequency of application depending on the heaviness of the soil. Refuse lime from sugar beet factories is used to a considerable extent, and the amount applied may vary according to the supplies available, farmers often being only

allowed to take lime in proportion to the quantity of beet delivered by them. Moreover, the high moisture content of this substance, with its relatively high transportation cost, restricts its use mainly to those growers who are close to the factories. Three or four tons per acre of this lime is recommended by the Agricultural Institute at Halle in Saxony.

Some typical manurial dressings per acre are given below :

GERMANY.

General

- 11 tons farmyard manure.
- 3 cwt. superphosphate.
- 2 cwt. 40 per cent. potash salts.
- $1\frac{1}{2}$ cwt. sulphate of ammonia.
- $1\frac{1}{2}$ cwt. nitrate of soda.

Rhineland.—River valley loam

- 8 tons farmyard manure.
- Crimson clover as green manure.
- $2\frac{1}{4}$ cwt. superphosphate
- 1 cwt. 40 per cent. potash salts.
- 1 cwt. sulphate of ammonia.

Hanover.—Heavy soil

- 18 tons farmyard manure.
- 3 cwt. superphosphate.
- No potash.
- 2 cwt. nitrate of soda.

HOLLAND.

Zeeland.—Medium loam

- 11 tons farmyard manure.
- $4\frac{3}{4}$ cwt. superphosphate 14 per cent.
- 2 cwt. 40 per cent. potash salts.
- 4 cwt. nitrate of soda.

Friesland.—Heavy soil

- No farmyard manure.
- 4 cwt. superphosphate.
- No potash.
- $2\frac{1}{4}$ cwt. sulphate of ammonia and nitrate of soda.

(This is following potatoes to which farmyard manure and artificials have been applied.)

FRANCE.

- 14 tons farmyard manure.
- $2\frac{3}{4}$ cwt. superphosphate.
- $2\frac{3}{4}$ cwt. kainit.
- 4 cwt. sulphate of ammonia.

BELGIUM.

Hainaut.—Heavy soil

- 16 tons farmyard manure.
- 4 cwt. superphosphate.
- 4 cwt. sylvinite, 20–22 per cent.
- 4 cwt. sulphate of ammonia.

Flanders.—Sandy soil

- 12 tons farmyard manure.
- 6 cwt. superphosphate.
- 2 cwt. muriate of potash.
- 2½ cwt. sulphate of ammonia.
- 3 cwt. nitrate of soda.

Hesbaye

Recommended by the Agricultural Institute at Gembloux:

- 14 tons farmyard manure.
- 6 cwt. superphosphate.
- 8 cwt. kainit.
- 0·8 cwt. sulphate of ammonia.
- 0·8 cwt. nitrate of soda.

The above is ploughed in 12 in. deep to induce root development. When the plants begin to show, they are top-dressed with 2½ cwt. of nitrate of soda; and at singling time a further 0·8 cwt. of nitrate of soda is given.

IV. SOWING AND SUMMER CULTIVATIONS

THE time of sowing has occupied a considerable amount of attention in experimental work on the Continent. The following table gives the results of an experiment carried out by Remy in Germany in 1922, which shows that late sowing is not advantageous:

TABLE VI. *Effect of Date of Planting*

<i>Date of planting.</i>	<i>Beet per acre.</i>	<i>Sugar.</i>	<i>Sugar per acre.</i>
	<i>Tons.</i>	<i>Per cent.</i>	<i>Tons.</i>
13 April . . .	16.5	16.4	2.70
5 May . . .	13.9	15.9	2.21
19 May . . .	11.0	15.6	1.71

Roemer's experiments at Halle confirm the advantages of early sowing. He states that each day that sowing is delayed in the first half of April means a loss of 4 cwt. of beet, 71 lb. of sugar, and $3\frac{1}{2}$ cwt. of leaves per acre, and that each day that sowing is delayed in the second half of April means a loss of $2\frac{1}{2}$ cwt. of beet and 44 lb. of sugar, and that the gain by earlier sowing is greater than the gain by delaying harvest. In Holland it was stated that experiments show that the farmers' practice of sowing about the *middle period* gives the best results, and that late planting is a bad practice, as the yield of root and sugar declines as the date of sowing advances.

The relationship between the time of sowing and the time of harvesting has also been considered by Remy. The following results of his experiment show how great the differences in yield can be when planting and harvest both lead in the same direction:

TABLE VII. *Effect of Dates of Sowing and Harvesting*

<i>Planting and harvesting.</i>	<i>Beet</i>	<i>Sugar.</i>	<i>Sugar</i>
	<i>per acre.</i>	<i>Per cent.</i>	<i>per acre.</i>
	<i>Tons.</i>		<i>Tons.</i>
Early planting and late harvesting	17.69	17.0	3.0
Late planting and early harvesting	9.36	15.0	1.4

In practice the drilling, except in the case of very small areas, is spread over a period of time, and varies according to the season and the nature of the soil. For example, in 1926 on one French farm sowing commenced on 1 April, and was not finished until 10 May, whereas in the following year the commencing date was 22 April, and work was accomplished more rapidly, being finished by 3 May. In Saxony—according to Saillard—the average date is 20 April, with a range from between the 10th to the 15th of April up to the 10th to 15th of May, although Roemer says that in Saxony and Anhalt the sowing should be finished by 10 or 15 April in normal years.

In Holland one Friesian farmer sows round about the 2nd of May. Farther south, in Brabant, on sandy soil, another farmer sows about the end of April. In Zeeland the sowing period is from the middle to the end of April. One Belgian farmer visited is a firm believer in early sowing. His dates of sowing are from the end of March to the first fortnight in April. He stated, 'If you sow early, you get a lot of bolters, but that is a sign of a good farmer, and yields are better. Late sowing gives fewer bolters, but the yield is poor, and it is a sign that the farmer was behindhand.' He, however, appeared to be earlier than two other Belgian farmers, the first of whom sowed his earliest beets on or about 4 April and his latest by 15 May; the second prefers to start in the beginning of April. In 1927 he was late in commencing, 20 April, but finished by 10 May.

On the heavier soils, and in districts where the climate is cold or wet, the sowing dates are necessarily not so early, while it was also stated that where the land is in good heart the sowing may be left a little later than usual.

It is abundantly clear that, relative to conditions of soil and climate, early sowing is to be recommended. Roemer says that when beets are sown early there are fewer failures, singling can be started early, and the ground is shaded sooner. It is, he states, the most effective way of increasing the yield.

The question of the width of drilling, combined with the distances to which the plants are cut out in the rows, is a matter of importance in relation to yield. Some idea of Continental farming practice in this respect will be gathered from the figures in the following table:

TABLE VIII. *Showing Area per Plant on Various Farms*

<i>Country and district.</i>	<i>Distance between drills. Inches.</i>	<i>Distance between plants. Inches.</i>	<i>Area per plant. Inches.</i>
<i>Holland:</i>			
Friesland . . .	13·8	13·8	190
Overijssel . . .	17·3	13·8	239
Zeeland . . .	15·7	12·0	189
North Brabant . . .	13·8	13·8	190
„ . . .	15·7	12·0	188
<i>Germany:</i>			
Harz . . .	19·7	9·8	193
„ . . .	17·0	9·0	153
„ . . .	15·0	10·0	150
<i>Belgium:</i>			
Namur . . .	15·7	15·7	246
„ . . .	15·7	11·8	185
„ . . .	17·7	9·8	174
Hainaut . . .	15·7	13·0	204
„ . . .	15·7	13·0	209
<i>France:</i>			
Aisne . . .	15·7-16·5	11·8	185-195
Nord . . .	13·8-15·7	12·0	166-188
„ . . .	17·7	14·0	248

While the drilling distance is in nearly every case very narrow, especially so on one or two farms in Holland, the cutting-out distance is fairly wide in most cases. The resulting area per plant is from 150 to 248 sq. in., but the most common area per plant appears to be round about 190 sq. in. This would give a theoretical stand of 33,000 plants per acre, the highest number being approximately 42,000 and the lowest 25,000.¹ The number of cases is too few to give any idea of the relationship of the area per plant to the yield secured, but the farmers visited all reported very good yields.

In most of these farms the distance given between the plants is the distance aimed at, but there was evidence to suggest that this width was not attained in practice. The tendency is for piece-workers, and especially those who are responsible for a definite piece of ground throughout the summer, to bunch widely, knowing that they will have less work to do both at singling and at harvesting. One Belgian

¹ Saillard, writing of Germany in 1910, gives the number of plants per acre as 40,000-48,000. Occasionally he found 36,000 or even 32,000, but this was rare.

farmer, who aims at 12 in. between the plants, states that 14 in., and even 15 in., is more like the final result, and another, who aims at 13 in., reckons that the plants are left at 14 in. This would raise the area per plant on the first of these farms from 185 to 217-232 sq. in., and on the second from 204 to 224 sq. in. per plant.

The question of the width of drilling and cutting-out has also been prominent in agricultural experiments during recent years, especially in Germany. The common distance in drill width was about 15 in., and the cutting-out distance about 12 in., slight variations in drill width being found according to the type of drill used. This close drilling was practised because, without detriment to the yield of beet, it was thought to be essential to high quality. The economy of labour never really entered into the question. The restriction of the casual labour supplies in Germany since the war has, however, emphasized this latter aspect of the problem. Experiments have therefore been designed to test the effect on yield and quality of increasing the drilling distances, and at the Lauchstadt experimental station, attached to Halle University, a distance of 19.7 in. between the drills, and half this distance between the plants, is now considered to be the best. This is found to give an even better sugar content than formerly, while the percentage of tare is less. More machine work and more thorough work is possible, and less damage is done to leaves. Remy estimates that the combined saving of labour in bunching, thinning out, hand hoeing, and harvesting by increasing the distance between the rows from 15.7 in. to 19.7 in. is 20 per cent. A distance of 17.7 in. is the least possible distance between the rows which he considers permits of loosening the soil along the rows right on into the summer. He quotes experiments which tend to show that the area per plant may in some cases be increased to 310 sq. in., provided the widely spaced roots ripen properly. Wide drilling and cutting-out are certainly detrimental both to yield of roots and of sugar if the beets are harvested early. The conditions which he lays down as counteracting this effect of wide planting are:

1. Warm soil and climate.
2. Careful early drilling.
3. All other circumstances which hasten early growth.
4. Moderate nitrogenous manuring.
5. The use of nitrogen at such a time that it promotes summer growth, but is used up by the autumn.

6. Abundant phosphoric acid manuring.
7. Cultivation of early ripening stocks.
8. Late harvest.

On the whole he is inclined to consider that it is desirable to act warily with wide planting. When circumstances are in favour of early ripening, rows 19·8 in. apart by 11·8 in. between the plants ought not to have a detrimental effect on the quality of the crop. Otherwise smaller distances are advised. Roemer mentions three conditions as being inimical to wider drilling: (i) heavy soils, where, owing to the weight (density or resistance) of the soil, the roots never grow large; (ii) soils infected by insect pests; and (iii) soils liable to get weedy.

Other attempts to economize labour have been made. One method is by criss-cross planting. In this method one half of the seed is drilled in one direction and the other half at right angles. By horse-hoeing in both directions after the seed is up, the plants are left in bunches, which saves the cost of bunching at the expense of one horse-hoeing, while further horse-hoeing can be carried out during the summer, thus saving additional hand-work. The difficulties in this matter are that the drilling has to be done in a square formation or as near to a square formation as possible, the narrowest widths of the cross distances being determined by the width within which it is possible to horse-hoe. As this is rarely less than 16 in., the final result is a *very* wide area per plant with a possible detriment to yield and quality.

Remy's own experience in the Rhineland with this method shows it to be satisfactory, and he quotes the following experiment in 1923:

TABLE IX. *Effect of Criss-cross Drilling.*

<i>Method of drilling.</i>	<i>Beets</i>	<i>Sugar.</i>	<i>Sugar</i>
	<i>per acre.</i> <i>Tons.</i>	<i>Per cent.</i>	<i>per acre.</i> <i>Tons.</i>
Criss-cross 15·7 in. × 15·7 in. . .	14·6	18·2	2·65
Ordinary drilling rows 15·7 in. apart . .	14·9	18·0	2·68

It is seen that there is no essential difference in the results of either method.

The use of drills which deposit the seed at intervals has also been tried. This method, however, only makes it possible to save the labour of bunching.

Cultivations between Drilling and the Appearance of the Plants

Cultivations carried out immediately after the drill and prior to the showing of the plant depend a good deal on the nature of the soil, the depth of drilling the seed, and the weather prevailing at the time. It should be remarked in passing that some drills seen in Germany and Holland have a roller attachment to the blade of the drill, working either in front of or behind the seed cups. This compresses the soil over the rows, and has the advantage that the greater part of the surface is left unrolled, so that moisture is conserved.

On the light sandy lands of Holland many rollings are given after drilling, especially if the weather is dry. One Brabant farmer, in the dry period during May 1927, rolled three times after drilling to ensure germination. Even on some of the heavier soils of Belgium and France, rolling is practised after a spell of dry weather. The rollers seen on one or two farms were of the heavier type, with knobbed projections, and served the double purpose of improving capillarity and of breaking any surface crust which may have formed. Flat rolls may also be used, and, after rain when there is a tendency for the surface to form a hard crust, harrows are similarly used. Also when the seed is planted deeply, as in late sowing, there appears to be a general consensus of opinion that harrowing is necessary to ensure quick germination and the appearance of the plants. When the ground is firm, as in a good seed bed, and adequately rolled after drilling, there is little fear of disturbing the roots of the young seedlings by harrowing. Roemer suggests harrowing twice before the plants are up, the first time four or five days after drilling, in a slanting direction to the rows, and then again at an interval of three or four days. A further harrowing, he says, should be carried out after the plants are $1\frac{1}{2}$ in. to 2 in. high. These harrowings keep the ground open, and weeds are destroyed. In fact the first horse-hoeing may then be dispensed with, while hand-work is made easier.

Operations after the Plants are up

Under present practices it is considered to be of the utmost importance to hoe between the rows immediately the plant is to be seen. On the small farms, and also on farms where the land is light, this is done by hand-hoes, or by the Planet Jr. form of hoe. The latter seem to be popular in many parts of Belgium and Holland; in fact, on the small holdings in those

countries and on the very light lands it is seldom that horse work is done at all. On the larger holdings steerage hoes are almost universally used. These take 2, 3, 4 and even 5 rows, and the team consists only of a horse and a man in most cases. Occasionally if the work is difficult, or the rows to be operated are many, a boy is also employed. It should be recollected, however, that it is the narrowness of the drilling that makes it possible to work hoes taking 4 and 5 rows. A horse-hoe with protecting discs taking 5 rows was seen in Holland, and was operated by a man, a youth, and a horse. In this case the horse walked along the centre row of beets, and it was claimed that no material damage to the young plants resulted from this practice. It is customary in the first horse-hoeings to set the blades narrow in order to avoid smothering the young plants, and shallow in order to kill the surface weeds.

Actual daily performances in horse-hoeing were given by two farmers in Belgium and France. The former, using a 3-row machine, stated that a good man would do $7\frac{1}{2}$ acres a day (10 hours), while the latter, using a 4-row hoe, expected as much as 11 or 12 acres to be accomplished in the same time.

A second horse-hoeing often follows, but under certain weather conditions the land may first be rolled. For example, if the weather has been wet after sowing, the first hoeing often leaves the land in a lumpy condition, and the purpose of the roll is to recover a fine tilth. Where moisture conditions are good, the land is left rolled; otherwise it is given a second horse-hoeing with the blades so set as to pass as close to the drill rows as possible.

This is the last operation immediately preceding the work of cutting out the plants. It is almost a universal practice to bunch the plants before actually singling them out. Delille says, 'the greater the care bestowed on this bunching, the easier will be the singling out. One should see therefore that the bunches are made as small as possible, with not more than 4 plants in each.' On most farms, therefore, only the best of the farm hands are entrusted to do this job, and personal supervision by the farmer is necessary to see that the work is well done. Occasionally, if the seed has not been sown too thickly, it is possible to separate out a single plant when bunching. The distance between the bunches may vary between 8 in. and 16 in. according to the thickness of the plant and to the ultimate spacing aimed at. Two strokes of

the hoe are necessary between each bunch. The first cuts out a space equal to the width of the hoe used. The second overlaps the first to an extent which depends on the distance at which the bunches are to be left, and is done with the hoe tilted at an angle. The speed at which this work is accomplished has been studied by Delille. The distance between the drills was 15.7 in., and between the plants 11.8 in. in each case.

TABLE X. *Rate of Work for Bunching*

<i>Worker.</i>	<i>Soil density.¹</i>	<i>Time taken to bunch per acre. Hours.</i>
Female, 24 years old	50-30	17.0
Farmer, father of the first, aged 64	50-30	19.3
Female piece-worker, 50 years old	100	21.6

A Dutch farmer on light soil estimated that a good man could bunch 1 acre in 2 days of 11 hours each, viz. 22 hours. The distance between the drills was 15.7 in. Roemer gives three examples of time taken by women in bunching, viz. 19.8, 12.9, and 12.7 hours per acre. The first was at day wages, the second and third on piece-work rates.

Immediately the plants are bunched, other workers follow for singling, though Delille recommends that previously to this another horse-hoeing should be given to reduce the soil density, to loosen the bunches, and to make the kneeling easier. In some districts of Belgium where piece-work is done, workers operate in pairs, one bunching and the other following on behind singling. On two farms visited, an acre was stated to be covered in this way by a pair of workers at piece-rates in 17 hours. Where gang labour is employed, one gang—usually men—do the bunching, while another gang, of women and children, follow for singling. Women and children are mostly used for the singling in all countries visited. Where gangs are employed, a ganger is in charge of some 10 to 12

¹ In all farm operations which have as their aim the moving of the soil, as in ploughing, hoeing, &c., the work accomplished depends essentially on the physical condition of the soil, i. e. on the resistance which it offers to the passage of implements or tools. Soil density, as stated here, is a measurement of such physical conditions by testing the resistance of the soil to the penetration of a special gauge, constructed by Delille, which is dropped on it from a height of 1 metre. In the table, a soil density of 50-30 denotes a low and of 100 a high degree of resistance. The gauge is manufactured by Ernst Bieling, Göttingen, Theaterstrasse.



BEETS BEFORE SINGLING, SHOWING WIDTH OF DRILLING, 15.7 INCHES

Holland, North Brabant



HORSE-HOEING BEETS WITH FOUR-ROW MACHINE

France



BUNCHING



SINGLING

France

workers. Supervision is essential. The work is done by hand, and in a stooping or kneeling position. One, two, or even three rows may be taken by each worker. The method is thus described by Delille:

Singling out is generally done in a kneeling posture. One hand rests on the ground and provides the necessary support for the body as it bends forward. Three rows are worked at a time. The centre row is taken between the knees; the left hand singles out the row on the left, the right hand that on the right, while for the centre row the hands are used alternately, depending on which one is supporting the body. The singling out is done by the thumb and first finger, and sometimes the middle finger is also used. The fingers must be poked into the earth so as to grasp the plant by the root, as the leaves easily break off. It is a good thing if there has been rain before the singling out is done, for then it is easier for the fingers to get down into the soil, nor do the knees ache so much, since the damp earth is springy. To rest the knees one should work from time to time in a stooping position. In this case only one hand is used. The elbow of the idle arm is propped on the hip on the same side, or the hand may be on the ground. By this means the muscles of the back are relieved to a considerable extent, but singling out in a bending position can obviously only be done for a short time.

The actual performance in 4 cases, 2 at piece-work rates and 2 at day wages, are given by Delille as follows. In each case the distance between the drills was 15.7 in. and between the plants 11.8 in.

TABLE XI. *Rate of Work for Singling*

<i>Method of payment.</i>	<i>Soil density.</i>	<i>Soil.</i>	<i>Time taken to single</i>
			<i>an acre.</i>
Piecework . . .	60	—	13.9
„ . . .	90	—	21.0
Day wages . . .	90-110	Clay	37.1
„ . . .	40	Sandy	23.4

Roemer gives two examples of the time taken by women, viz. 28.2 and 20.9 hours per acre. The first represents day wages and the second piece-work. The importance of doing the work by piece-rates and of a low soil density are evident.

After the singling is completed, and so soon as the plants recover an upright position, they are again horse-hoed either once or twice. Top dressings are usually applied before one or other of these horse-hoeings. The object of the horse-

hoeings is to keep down weeds, to prevent evaporation of moisture and to facilitate the work of the second hand-hoeing which follows.

This hand-hoeing completes the work of the horse-hoes by breaking up the crust between the plants in the rows and by removing weeds. This is considered to be the slowest of all the hand operations. Weeds close to the individual plants have to be taken out by hand, and any doubles left in the singling have now to be removed. This reduces the pace of the work. The work is done with a narrow hoe, and it is advisable not to wait until the plants are too big, as the leaves may then be broken off or damaged.

Delille, again, gives some records of performances for this operation:

TABLE XII. *Rate of work for Hoeing.*

<i>Working conditions.</i>	<i>Hours of hoeing per acre.</i>
Weedy piece of ground (bunched by children) .	28.1
Ground free from weeds	20.0
Ground free from weeds, previously horse-hoed .	12.8

Roemer also cites three performances by women, viz. by day work 33.0 hours, by piece-work 17.4 and 21.7 hours per acre.

It will be noticed in Delille's figures that bad bunching resulted in a large increase in the time taken on the second hoeing, while it was extremely beneficial to horse-hoe previously. Delille suggests that if piece-work is done on this operation, the beneficial effect of horse-hoeing should be taken into account when the rates of pay are fixed.

It is customary to follow this operation with one or more horse-hoeings, until the growth of the plants prevents further horse-work. In these later hoeings the blades are set narrow and at a greater depth. The goose-foot type of hoe is used. On several farms in Belgium and Germany the last horse-hoeing is done with a special type of hoe, fitted with an inverted V-shaped attachment which throws the soil towards the plants and acts as a sort of earthing-up, while at the same time a number of small weeds are buried under the leaves of the plants. Altogether during the summer as many as seven horse-hoeings may be given, while four and five are quite common. It was always recommended to keep the horse-hoes at work as long as possible, since the yield was appreciably increased thereby.

V. HARVESTING

The Date of Lifting

THIS question is no less a matter for debate on the Continent than it is in this country. There is, of course, a moment in the life of each root when its sugar content reaches the maximum point. Ideally, the sugar should be extracted from it at that moment. Thus the farmer would be paid for the greatest quantity of sugar which his crop could produce, and the factory would obtain that sugar from the minimum amount of raw material. For obvious reasons, however, this is a condition impossible to attain in practice. In the first place, the crop must be lifted by fields and not by individual roots; and secondly, both the lifting of the roots and the extracting of the sugar take time. Hence, both farmer and factory weigh up the forces at work, and arrive at a compromise.

There are two conflicting requirements on the part of the factory. On the one hand, the period during which the factory can work at full capacity should be as long as possible in order to reduce overhead expenses. On the other hand, the higher the quality of the roots worked, the lower is the cost of working, and for this reason the period during which the factory is to work should be as short as possible, so as to coincide as nearly as may be with the moment of highest sugar content of the roots.

The farmer is between the horns of a similar dilemma. To obtain the highest yield of sugar he should pull all his roots at the moment of highest sugar content, while to attain efficiency in working the farm he must spread the work of pulling over a considerable period of time.

From the point of view of the factory, the campaign must finish before the advent of serious frosts, as these cause heavy losses of sugar in the large reserve supplies of roots which it is necessary to store in flumes. The factory authorities, therefore, fix the date at which they wish to cease working, and calculate from this the date at which it will be necessary to start the campaign, if they are to work the expected quantity of roots. This frequently brings the opening date into the early part of October, or even the end of September.

The moment of highest sugar content in a normal season, and with the usual varieties of beets grown, falls somewhere about the month of November, and it is obvious therefore that the roots which reach the factory before this date will not contain so much sugar as they would were they allowed to continue their growth. In this way the factory cannot avoid losing a certain amount of sugar.

The farmer is equally concerned to see the campaign finish before the weather becomes too bad, but in so far as he can harvest his whole crop in a much shorter space of time than that needed by the factory for manufacturing its total intake of roots, he need not start his harvesting so early as the factory needs to start working.

The tendencies, therefore, are for the farmers to delay their harvesting, and for the factory to be short of raw material until perhaps the beginning of November, after which the farmers harvest and deliver their roots as quickly as possible, and the factory tends to become congested. This occasions the necessity for clauses in the contracts by which the farmers undertake to deliver their roots at regular intervals, and wherein they suffer the double disadvantage of losing sugar in their early deliveries and of having the work of the farm disorganized.

There are ample experimental data to show that the loss of sugar by early harvesting is considerable, and as an example the following figures of Gerlach (quoted by Roemer) are given:

TABLE XIII. *Effect of Date of Harvest. Yield of Sugar per acre for the Average of Four Varieties of Beet.*

<i>Date of harvest.</i>	<i>Sugar per acre.</i>
	<i>Tons.</i>
17 September	2.25
7 October	2.59
End of October	2.88

Moreover, in addition to a loss of sugar, which affects both farmer and factory, there is a loss to the farmer of by-products, both of tops and leaves and of pulp.

It is recognized that in a normal year the factories must start working before the roots have fully matured, and that both they and the farmers must thereby expect to lose some sugar, but complaint has arisen in Germany in recent years owing to the fact that the factories have often finished their

campaign by the beginning of December. The acreage of beet has declined, and the yields have been less, with the result that a smaller tonnage of beet has been worked. This should have enabled the factories to start their work at a later date, but instead of forecasting their needs and counting back from the end of December, they have aimed at opening at the same early date which was originally necessary when a larger quantity of roots had to be worked, and have closed down a month earlier than they need, with the result that they have been compelling farmers unnecessarily to deliver immature roots.

The remedy suggested is that a forecast of the yield of roots to be expected should be made, and that the dates of the campaign should be fixed accordingly around the optimum point. It would also seem to be an advantage to grow a fair proportion of roots from strains of seed specially selected for early ripening.

Methods of Harvesting

On the Continent, where labour is on the whole plentiful and relatively inexpensive, the choice of method of lifting is dictated largely by the extent to which the tops can be preserved from damage, so as to yield their maximum value as fodder. This damage consists mainly of their becoming covered with dirt and grit, which makes them unpalatable and sometimes dangerous. Towards overcoming this difficulty, some headway has been made in the introduction of plants for washing and drying the tops. Such plants can, of course, only be justified on large farms, where the quantity of tops to be dealt with is considerable. In the meantime hand-spudding is usually preferred to mechanical lifting, and it so happens that two other considerations also favour this method. First, the fact that the great growth of leaves which is encouraged for the sake of the fodder thus provided makes mechanical lifting difficult; and secondly the fact that mechanical lifting cuts up the ground to an extent which may make carting extremely difficult in wet weather. Where hand-spudding is for any reason impracticable, ploughing out by machine is resorted to, preferably by oxen. Ploughing out by horses is said to damage the leaves more than any other form of lifting. Steam tackle is sometimes used for the purpose, and there are also several makes of mechanical lifter and topper which are occasionally seen.

*Lifting**I. Hand-spudding.*

There are two main forms of spud in use (see fig. 2), of which the forked type is coming into favour at the expense of the spade type, which is falling into disuse. Both of these tools are used in the same way. One hand grasps the top of the handle, while the other holds the shaft, and the spud is

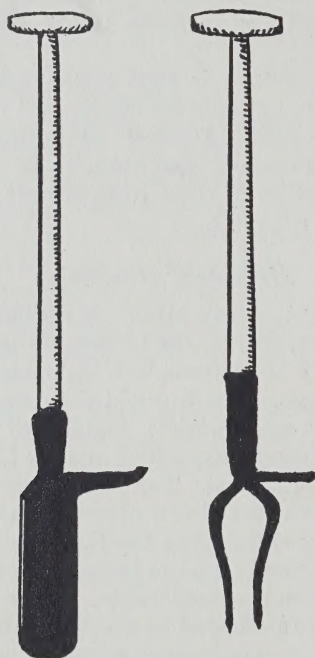


Fig. 2. Types of Spud

thrust into the ground alongside the root, being driven home, if necessary, with a foot. The spud is then used as a lever, the shaft being pressed downwards by the upper hand while the other hand takes hold of the leaves of the root and draws it out of the ground. The root may be knocked against the handle of the spud, or, more frequently, laid on the ground as it is. Each worker usually works along two rows at a time walking backwards, taking one root from each row in turn, and laying the roots from both rows in a single row.

The rate of working is approximately a quarter of an acre a day. Actual records (reported by Delille) of piece-work show:

	<i>Hours per acre.</i>
Heavy clay	47.6
Sandy clay	38.5
Sand	31.4

In parts of Belgium and Germany the spade type of spud persists for the reason that one of its edges may be sharpened sufficiently to allow it to be used for topping the beets as they lie on the ground after being lifted.

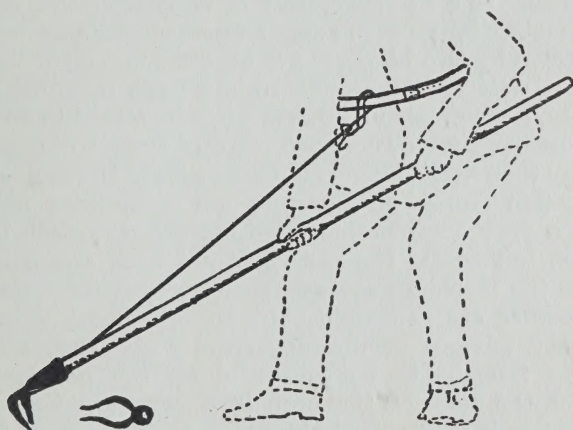


Fig. 3. Prong for lifting Beet

A third type of implement takes the form of a prong, such as is shown in Fig. 3. This implement has the advantage that the worker does not stoop to the same extent, nor, in Roemer's opinion, are the roots so liable to damage as when an ordinary spud is used. The method of work is for the labourer to strike the hook into the soil behind the beet. A chain, or strap, is attached from the waist of the worker to the lower end of the handle of the prong, so that by throwing the weight of his body backwards the worker can draw the beet out of the soil without unduly exerting his arms. In other districts no chain is fitted to the prong, which is then only used for pulling the roots after they have been loosened by a plough. The teeth of the prong in this case are shorter, and they are applied actually to the root rather than to the soil behind it.

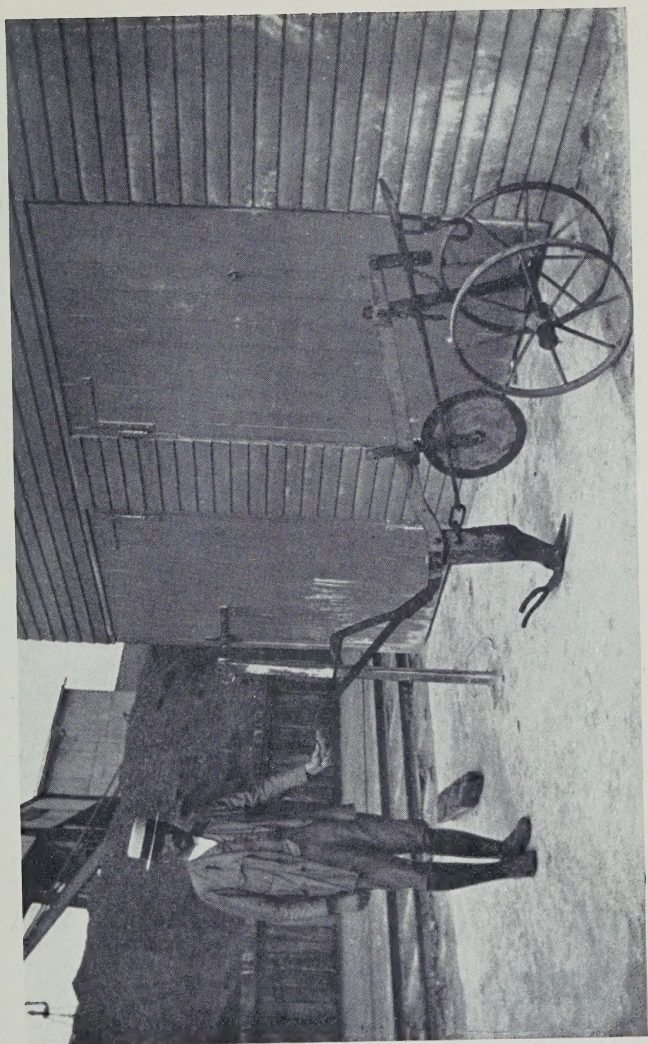
II. *Machine Lifting.*

(a) *Oxen.* A team of 4 oxen with a boy to drive and a man to steer a double-row lifter covers $2\frac{1}{2}$ to 3 acres per day. This method is mostly met with in Germany.

(b) *Horses.* This method is usually adopted on farms where draught oxen are not available, and where hand-spudding is the normal method employed. It happens on such farms occasionally that after a dry summer the land is so hard that hand-lifting becomes too difficult. In such cases a horse-lifter is called into use. On one farm in Belgium it was found that this had only occurred once in the last six years. Horse-lifting as a regular feature of beet-harvesting is very seldom met with, except in France, where an ordinary one-row lifter drawn by two horses is not uncommon.

(c) *Complete harvesters.* There is a large range of these machines, none of which, however, can be stated to be completely satisfactory. There are more of these to be seen in Germany than in the other countries visited. In Holland, the Co-operative Group of Factories are understood to have offered a very considerable prize for a satisfactory lifting machine, but so far the prize has not been awarded. In Belgium the machines are said to work well when the soil and weather are just right, but to fail under the more customary adverse conditions. In any case they are not generally thought to be successful on the heavier soils on which the bulk of the crop is grown. On the sandy limestone soils in Hainaut they give satisfaction so far as the work is concerned (especially the lifting, as opposed to the topping units), but it is found that they cannot compete economically with the cheap Flemish labour available in that district.

In Germany beet-harvesters are said to be slowly gaining ground, and this may be partly accounted for by the restrictions recently imposed on the immigrating labour gangs, which tend to make hand-lifting more expensive than it has been hitherto, as well as by the fact that the machines themselves are being improved. Roemer, commenting upon the shortage of labour, draws attention to the fact that conditions are likely to become even worse owing to the lowered birth-rate during the war, which will start making itself felt about 1930. He therefore welcomes the appointment by the German Government of a Commission to encourage the mechanization of beet harvesting. The opinion of one expert



A COMMON TYPE OF HORSE-DRAWN LIFTING MACHINE

France

economist was that machines are at present still in the experimental stage, but that in about six years' time satisfactory harvesters will be an accomplished fact.

In the meantime the main objections to machine harvesting seem to be the difficulty of uniform topping, the clogging of the machine by a crop with a heavy yield of leaves, and, above all, the fact that the fodder-value of the leaves is nearly always less than when they have been treated by hand only.

Topping

The subsequent treatment of the beets varies from farm to farm. Where a complete harvester is used, nothing remains but to collect up the roots as left on the ground by the machine. In the majority of cases, however, the roots, whether spudded or pulled by hand after being loosened by a lifting-plough, have to be topped and made ready for drawing off the field.

Where a lifting-plough has been used, the pulling usually consists of taking hold of the leaves of the beet and pulling the roots clear of the ground. One beet is pulled by each hand, so that they can be knocked together to remove some of the dirt, and the beet are then laid on the ground, 2 rows of growing beet going to make a single row of pulled beet. In those cases where the roots are drawn out onto the surface of the ground by means of a prong (see p. 39), the roots are not knocked, nor can the rows be laid together, a single growing row thus becoming one row pulled. Moreover, they are not laid evenly, and topping them as they lie on the ground is therefore more difficult. The worker, however, can cover the ground at a rapid rate without fatigue. Where such an implement is used, it may be followed by a second worker who knocks the beets and lays them down again, two rows making one row, taking care to leave them handy for topping on the ground; or, as in the Kyffhäuser district of central Germany, according to Roemer, the worker may pull five rows at a time, and draw the pulled beet into small heaps with the prong as he goes along. In this case, of course, topping on the ground becomes impossible.

When collecting two growing rows into one row of pulled beet, the roots, whether spudded or hand-pulled, are usually laid as shown in Fig. 4.

In this way, if the topping is to be done without again lifting the beet from the ground, the worker can walk along the space between rows 2 and 3 and between rows 6 and 7. The gap between rows 4 and 5 is mainly occupied by leaves, which should not be trampled upon.

In some districts, notably in Upper Silesia, as many as 6 growing rows may be collected into 1 row for topping. This method suffers from the disadvantage that the topping cannot so easily be done by a worker standing erect, and in fact it is often necessary to kneel in the mud. It is a common practice, however, especially among Polish workers, to take

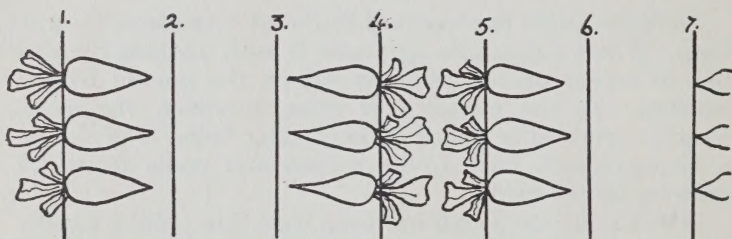


Fig. 4. Showing how Beet are laid in rows

the roots one at a time from the row into which they have been collected, and to hold them in the hand when topping them. In this event it is not necessary to exercise the same care when throwing the beet into the collecting row as must be used if the roots are to be topped without being lifted from the ground.

Implements used for topping by hand.

A. When topping is to be done with the roots on the ground:

(i) The worker standing:

- | | |
|--|------------------------|
| (a) spade-type spud with sharp edge | } topping by striking. |
| (b) long-handled knife | |
| (c) turf-cutting type (topping by pressure). | |

(ii) The worker stooping or kneeling:

- (d) hatchet type (Fig. 5).
 (e) 'pressure' type (Fig. 5).

B. When the roots are lifted from the ground in order to be topped.

(i) The worker standing:

(f) hatchet type (Fig. 5).

(g) sickle type (Fig. 5).

While the implements under heading (c) differ from those under heading (e) in one point only, namely the length of the handle, they both differ in principle from the other implements in that the topping is done by exerting pressure after the cutting edge has been placed against the root.

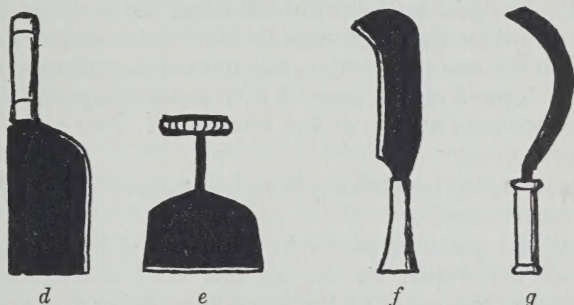


Fig. 5. Various types of implements for topping by hand.

When any other implement is used, the topping is performed by striking a blow at the root. The topping by pressure would enable more accurate work to be performed, provided the root remained firm, but in point of fact it is usually necessary to steady it with the foot or hand. Moreover, with constant practice the workers who top by striking achieve an accuracy of aim fully as true as that of the pressure method. When compared from the point of view of speed, it has been found in Germany, in the course of investigations by Sannes (reported by Delille), that there is a saving of time of approximately 8 per cent. in favour of topping by striking.

As between the various implements for topping by striking, the main differences lie between topping on the ground and topping in the hand. Topping on the ground with a long-handled implement (a and b above) is less accurate, and it leaves the roots to be gathered subsequently into heaps or rows, but it has the advantage of being less fatiguing. Where a short-handled implement is used (d above) the topping is done more accurately, but is more tiring. Dralle, however, finds that if the left hand is used to throw the roots into a

heap so soon as they are topped, instead of leaving them for a second journey, fatigue is reduced and speed is gained.¹ When the roots are taken in the hand before topping, an ordinary hatchet (*f*), similar to, but rather lighter than type *d*, may be used, but the better implement is the sickle-type (*g*), which enables the root to be lifted more easily. The worker strikes lightly with the point of the sickle into the root, and draws it up, sticking to the end of the sickle, so as to take it in the free hand without having to stoop. The root is then easily topped and thrown into a heap. By this method, which is favoured by Polish workers, the rate of work is stated to be equal to that attained when the roots are topped on the ground with a short-handled hatchet and thrown on to a heap on the second journey, but to be slower than when the roots are topped on the ground with a short-handled hatchet and thrown into a heap at the same time. Two main points therefore emerge:

- (1) that topping by striking is to be preferred to topping by pressure, and
- (2) that the quickest method of topping is by striking the roots while still on the ground with a short-handled hatchet, the roots at the same time being thrown on to a heap with the disengaged hand.

Collecting into Heaps

There remains to be considered the question of collecting the topped beets into heaps or rows ready for the loading, which is a necessary preliminary to hauling.

This work of loading is considerably affected by the way in which the beets are left after being pulled and topped. They may be left in rows or in heaps, and the heaps may be large or small. Which ever method is adopted, the wagon must be driven alongside the beets, and it has been shown by Delille in Germany that there is a very considerable saving of time in loading beets from large rather than from small heaps. This is due to the fact that with small heaps it is seldom that more than one or two heaps at a time will be so situated as to be convenient for loading into the wagon, whereas when large heaps are being loaded, all the roots lie ready to the workers' hands, and time is not occupied in driving the wagon from place to

¹ Dralle (reported by Delille) finds that 13 per cent. more work is done in a given time when the beets are thus topped and thrown during the same journey.

place. Moreover, the convenience of loading from large heaps is such that piece-work rate of wages can be paid, which is found to be impossible when loading from small heaps. There is an additional saving by the large-heap method, namely that the horses are not required until the wagon is full, whereas when the roots are left in rows or in small heaps, the wagon must constantly be moved. This necessitates keeping sufficient horses standing about to pull the wagon over rough ground, not only when it is empty, but also when it is nearly full.

These points have to be borne in mind when organizing the earlier stages of the harvesting operations. In Germany, the general arrangement of the harvesting takes one of two forms:

- (a) Harvesting by rows and small heaps.
- (b) Harvesting by plots and large heaps.

(a) Harvesting by rows and small heaps.

The actual pulling and topping is carried out in one of the ways already described, and the roots are collected into heaps either at the time of topping or the worker may make a subsequent journey for the purpose. The heaps are usually made about once every 10 yards with the beets collected from 12 growing rows. Each heap is covered with leaves, and the leaves not required for this purpose are forked into small heaps. With rows 15·7 in. apart each heap contains about 340 roots, and takes about 40 minutes to make (including pulling, knocking, topping, heaping, and covering with leaves, &c.). An experimental plot was covered in this way at the rate of 49 hours working time per acre.

(b) Harvesting by plots and large heaps.

This method is more commonly adopted where casual labour is employed on the larger farms. The plots are usually between a fifth and a sixth of an acre in size, and the roots are pulled and topped as before. The difference arises in that, either during or after topping, the roots from the whole plot are collected into a single heap. In practice those roots which are not more than 10 yards from the centre of the plot are thrown, but the remainder, which amount to approximately half the number of roots on the plot, have to be carried. For this purpose wheel-less barrows carried stretcher-fashion by two workers are used. These barrows, which are made of wooden spars, weigh about 20 to 25 lb. when empty, and

contain about 1 cwt. of roots and dirt when full. The heap is covered with leaves, and the remaining leaves are collected up into small heaps as before. By this method an experimental plot was covered at the rate of 52 working hours per acre, as against 49 hours by the small-heap method.

When it is considered, however, that when loading from large heaps there may be a saving of some 46 per cent. of the time taken in loading from small heaps, in addition to a considerable saving of horse-labour, it is not difficult to understand why harvesting by plots and large heaps is often preferred.

The practices in other countries are very similar to those found in Germany, and it is interesting that differences in method occur between one farm and another rather than between districts or countries. The collecting of the roots into heaps before loading is undertaken for two main reasons, first to facilitate loading, secondly to facilitate cleaning. It is more commonly practised where there is likely to be delay in carting than when the roots are to be taken off the field immediately, but the reason for covering the heaps with leaves is not primarily to preserve the roots, but to assist in their cleaning. The leaves keep off the rain to some extent, and the warmth of the roots causes the dirt to dry so that it more readily crumbles off when the beet are next handled.

Although the making of heaps is a common feature, it is by no means universal, and in Belgium and France it is often the practice to throw the topped beets into collecting rows, 6 or 8 growing rows forming one such collecting row. The tops are gathered into rows alternating with the root-rows, and the topped beets are then partly cleaned by means either of a heavy wooden harrow or of a chain harrow, which is pulled along the root-row usually by two horses, one horse walking on each side of the row. This operation is repeated two or three times, according to the weather. This method is very effective and saves a great deal of labour given the right kind of soil, but it cannot of course be recommended where the soil is very sticky.

Another condition which gives rise to collecting the roots into rows rather than into heaps is found throughout the Continent wherever large farms are so situated as to have easy access to a railway. In such cases, instead of hauling the roots off the fields by wagons, it is a common practice to employ portable railways of the Decauville type. All the

roots growing within reasonable range are thrown into a large collecting row, alongside which the portable track is laid. The truck is pulled along the track by a single horse, and so soon as one row has been lifted, the rails are re-laid alongside the next. Given the requisite situation and size of farm, the method has certain obvious advantages, though it is essentially a practice which cannot be greatly extended.

In districts of severe November frosts, the beets which are intended for late delivery are lifted in the early part of the campaign and are stored in clamps. These do not necessarily take the form of single clamps alongside the road. There are often many low and narrow clamps in each field reaching across it from side to side. They are covered with straw and earth in the usual manner. In those countries where severe and prolonged frosts are not usually experienced before the New Year, elaborate clamping methods do not assume the same importance. In Belgium, for example, where the climate is similar to that in this country, lifting may begin in the first half of October and finish before the end of November. The frost is never strong enough to cause a delay of more than three or four days, and clamping is not practised at all. One precaution, however, which is taken, is to sow and harvest first those fields which are farthest from the road.

VI. YIELDS

(a) *Roots*

A PERUSAL of the foregoing chapters concerning the methods of cultivation of the sugar beet crop will have conveyed the impression of a use of man power and of fertilizing materials on a scale which is not usually found in this country. It is therefore to be expected, apart from any question of natural conditions such as soil and climate, that with intensity of production of the degree indicated the yields of crops would be high. In approaching the question of yields it is well, therefore, to remember the economic conditions underlying agricultural production in these countries. Political expediency, rather than economic causes, may entirely change the extent of production in any industry; and, in some of these countries, strong factors have been operating to stimulate farming policy. For example, national economic policy in Germany prior to the War was directed to the greatest home-production of foodstuffs as an insurance against war risks, and consequently its agriculture was protected against competition of imported foods by a strong tariff scale covering a wide selection of agricultural produce. The effect of such a policy on agriculture has been stated by Professor Macgregor.

It is plain that in old countries, where the land is already taken up, the effect of protection which is specially favourable to agriculture is to create the possibility of more intensive cultivation. As a typical measure of this influence, the German tariff on wheat was over 30 per cent. of the British price before the war: this must react strongly on the gross acreage production.

In particular reference to the sugar beet industry in Germany, Sir William Ashley has remarked:

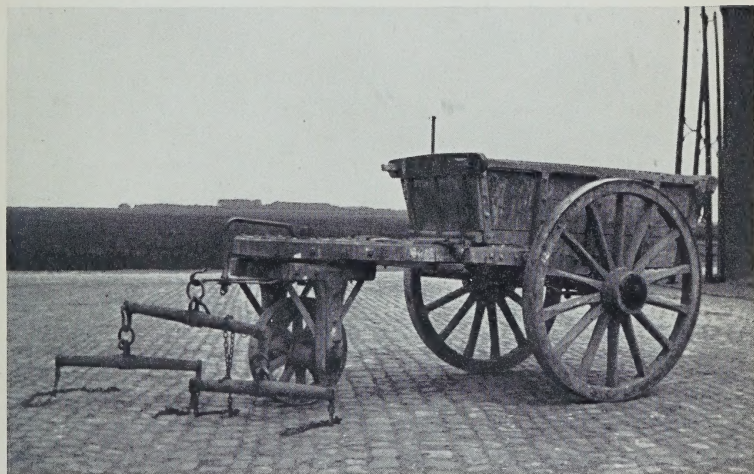
The cultivation was made more profitable by import duties, by bounties (down to 1913), by a cartel which gave additional bounties to sugar sold abroad below the domestic price, and of course by the free trade policy of England.

As in Germany, so it was in France, and to a slightly less extent in Belgium, that political measures of protection to agriculture generally have influenced the scale of profitable



TYPICAL WAGON

Germany



TYPICAL WAGON

France



TWO COMMON TYPES OF PIT SILOS

(See p. 69)

agricultural production in these countries. Measures embodying protection of home-grown foods still prevail in these countries.

When the case of Holland is considered, no similar argument can be advanced to account for the intensive scale of farming practised in that country. No one, however, can travel throughout the Netherlands without recognizing the fact that agriculture is the main basic industry, while the absence of manufacturing industries is everywhere striking. National policy need not be directed, therefore, to the benefit of great manufacturing industries relying on export trade and the importation of cheap food to sustain an industrial population. In fact the reverse is the case, for, with very little raw material of her own, Holland has had to make the very best of the one great industry she commands, viz. agriculture, and, by farming up to the highest possible limit, to obtain a large exportable surplus of agricultural produce by which she could buy coal and other industrial products.

Another factor applying to all four countries under review which has certainly influenced a greater output of agricultural produce is the fact that in these countries small holdings are common. This is the result either of pressure of population on a limited agricultural area (as in Holland), to a conscious development by the State, or to the system of inheritance of land. The percentage of holdings in England under 50 acres is approximately 66 per cent., while in France it is 90 per cent., in Germany 92 per cent., in Belgium 95 per cent., and in Holland 90 per cent. One of the phenomena of small holdings is that their physical output is greater than on large farms. The point is well illustrated in the statement of the *Agronome de l'État* of the province of Namur, Belgium: 'The small man with only 1 hectare (of beet) obtains a yield of 15·8 to 17·8 tons per acre, whereas the large farmer only obtains 11 to 12 tons per acre.' Production has to be higher on these small holdings in order to meet the high cost of renting or owning land and the prodigal use on them of man labour.

The following table gives the yields in the four countries:

TABLE XIV. *Yields of Roots.*

Year.	Holland. ¹		Germany. ²		Belgium. ³		France. ⁴	
	Yield per acre. Tons.	Index 1909-13 = 100.	Yield per acre. Tons.	Index 1909-13 = 100.	Yield per acre. Tons.	Index 1909-13 = 100.	Yield per acre. Tons.	Index 1909-13 = 100.
1901	14.72	121	13.31	118	—	—	10.61	107
1902	10.97	90	10.52	93	—	—	9.91	100
1903	9.64	79	12.19	108	—	—	10.30	104
1904	11.82	97	9.64	85	—	—	8.77	89
1905	13.53	111	13.31	118	—	—	11.23	114
1906	12.81	105	12.63	112	—	—	9.75	98
1907	11.79	97	11.95	106	—	—	9.53	97
1908	13.03	107	10.79	96	—	—	10.37	105
1909	10.83	89	11.23	99	10.84	99	11.12	112
1910	11.56	95	13.14	116	11.98	109	9.61	97
1911	14.37	118	7.17	64	10.22	93	7.23	73
1912	13.38	109	12.11	107	11.14	102	11.60	117
1913	11.01	90	12.67	112	10.58	97	9.49	96
1909-13	12.21	100	11.28	100	10.95	100	9.88	100
1914	12.57	103	11.67	103	—	—	10.64	107
1915	12.09	99	10.52	93	—	—	7.23	73
1916	10.57	87	9.52	84	—	—	9.22	93
1917	12.71	104	9.56	85	—	—	9.59	97
1918	12.93	106	9.48	84	—	—	6.35	64
1919	11.21	92	7.41	66	10.17	93	7.34	74
1920	11.40	93	9.56	85	10.80	99	10.08	102
1921	13.23	108	9.01	80	10.04	92	8.67	87
1922	12.95	106	10.40	92	11.21	102	11.34	115
1923	10.16	83	8.61	76	11.20	102	9.93	100
1924	13.08	107	11.12	98	12.22	112	11.42	115
1925	13.43	110	10.04	89	11.97	109	—	—

¹ Official statistics.
² Official statistics.

³ From the Verein der Deutschen Zucker-Industrie, Berlin.

Figures are given for Holland, Germany, and France since 1901, and for Belgium from 1909. The average yield in the five pre-war years, 1909 to 1913, is shown for each country, and has been taken as a standard for comparison.

The average of these five pre-war years shows that Holland had the best yield with 12·21 tons, followed by Germany with 11·28 tons, and that France was last with 9·88 tons per acre. In the cases of Germany and France the average yield of the 'standard' years is somewhat prejudiced by the yield of the year 1911, when, owing to a serious drought which appears to have affected the yields in these countries alone, the figures of 7·17 tons in Germany and 7·23 tons in France were recorded. Even if all the yields from 1901 to 1913 in these countries are taken, however, the average still does not equal that of Holland for the same period.

Leaving out the war years in those countries particularly affected by the conditions of the period, the main feature of the table is the steady nature of the average yields secured. Years of poor yields are infrequent. In France and Germany the effect of the war is most marked. The yields fall considerably and become much more variable. The figures are interesting as showing the effect of a less intensive policy of farming, resulting in lessened and perhaps inadequate cultivation of the soil, and insufficient manuring. In Germany other reasons are also put forward for the low yields in that country in recent years. Soils are said to be *beet-tired* on account of nematode disease, while it is also claimed that breeders of beet seed have paid too much attention to the sugar content and neglected the equally, if not more important, factor of yield of roots.

So far as the possibility of increasing the yield in the future is concerned, something may be learned from the statistical averages of yields in Holland in the three decades from 1891, which are as follows:

<i>Years.</i>	<i>Tons per acre.</i>		
1891-1900 . . .	11	99	
1901-10 . . .	12	11	
1911-20 . . .	12	15	

There is a small but perceptible successive increase on average, and if yields since 1920 are maintained, a fractional increase for 1921-30 should be recorded. It is noteworthy too that the acreage of beet grown in the decade 1911-20 was 56 per cent. greater than in 1891-1900.

Turning now to a consideration of the yields in the different districts and soils of the various countries, a table is given below showing the average yields of the various provinces in Holland for the years 1911-20 and for 1925:

TABLE XV. *Yields per acre in Holland, by Provinces.*¹

	<i>Groningen.</i>	<i>Friesland.</i>	<i>Drenthe.</i>	<i>Overijssel.</i>	<i>Gelderland.</i>	<i>Utrecht.</i>
	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>
Average 1911-20 1925	11·67 13·63	11·87 13·51	11·28 12·31	11·44 13·55	10·20 11·56	9·08 5·86
	<i>North Holland.</i>	<i>South Holland.</i>	<i>Zeeland.</i>	<i>North Brabant.</i>	<i>Limburg.</i>	<i>Holland.</i>
	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>	<i>Yield. Tons.</i>
Average 1911-20 1925	11·87 12·91	12·27 14·74	13·15 14·06	11·72 11·72	11·32 12·79	12·15 13·43

Here again the yields are uniformly high. Only in the province of Utrecht, which is almost wholly under grass and in which only some 250 acres of beet are grown, does the average yield fall below 10 tons per acre. The most important beet-growing provinces are Zeeland, North Brabant, South Holland, Groningen, and Friesland, and in these the average yields in 1911-20 were 13·15, 11·72, 12·27, 11·67, and 11·87 tons per acre respectively. Ample confirmation of these yields was obtained by the writers from farmers, agricultural experts, and factory officials in all the districts visited. The Co-operative factory at Zevenbergen in North Brabant, which draws its supplies from that province and from Zeeland, works every year an average of 11·86 tons per acre, the best annual average being 13·83 tons per acre. Two classes of soil—one a heavy soil and the other a sand—are found in the areas drawn upon by this factory, and both are used for sugar beet growing, though the heavy soil is favoured. Around the factory the soil is of the sandy type, where the Director states that the range of yield is from 13·83 to 19·66

¹ Official statistics.

tons per acre. Two farmers on light sandy land near Bergen-op-Zoom in the same province secure an average yield of 15 tons per acre. In the extreme north of Holland, in Friesland, a farmer stated that his average yield is about 15.8 tons per acre, which he considers good. This is on a soil which is typical of the arable district of the province, namely sea clay, an alluvial formation similar in texture to parts of the Lincolnshire fens.

A little further south, in the province of Overijssel, the Director of Agricultural Education has been experimenting with growing beet on the blowing sands which occur in that province, and has obtained the satisfactory yield of 11.86 tons per acre. This was to the writers a most surprising result, as the soil resembles the sand of the sea shore in yielding to the weight of the foot and filling up again immediately after pressure was released.

It must, however, be recognized that the success of beet growing on these and other sandy soils in Holland is very largely due to excellent supplies of moisture. Holland is a low-lying country, the water level is never far away, and the supply of moisture in the soil can be regulated to a large extent by the excellent drainage system which is in existence in the country as a whole. In fact it is claimed that in years of drought, when Germany, France and other neighbouring countries suffer, the yields of Holland are exceptionally good.

A broad picture of the yield obtained on the various classes of soil and the relative importance of these soils in sugar beet growing in Holland is given in the following table:

TABLE XVI. *Holland. Area of Sugar Beet and Yields on various Soil Classes in 1925.*¹

	Area of sugar beet. Acres.	Yield per acre. Tons.
Sea silt with arable and mixed farming	128,225	13.79
River silt with mixed farming	12,224	11.75
Peat and sandy soils. Grass districts	5,357	12.39
Sandy soils	12,110	12.19
Veen-Kolonien (soils reclaimed from peat moors)	4,638	12.67
Horticultural land	519	12.35
Holland	163,073	13.43

¹ From official statistics.

The importance of 'Zeeklei' or sea-silt soils—being land reclaimed from the sea—for the cultivation of sugar beet is very striking, nearly 80 per cent. of the crop in Holland in 1925 being grown on this formation. This soil forms the great bulk of the soil of Zeeland, the seaboard of North Brabant, the islands and south seaboard of South Holland, the north-east part of North Holland abutting on the Zuider Zee, and the northern part of Friesland and Groningen. The average yield on this soil is nearly $1\frac{1}{2}$ tons greater than on the other classes of soils.

The river silts, which are the next important group, are alluvial soils found adjoining the great rivers, the Waal, the Leck, and the Yssel, and most of the smaller rivers. The average yield on these soils was 11.75 tons per acre in 1925.

Of equal importance to the river clay are the sandy soils, which are widely distributed in Holland and which yield an average of 12.19 tons per acre.

These two latter classes of soil and the others mentioned in Table XVI are not important sugar beet soils. The development of the crop on these soils must be regarded as accidental and due to the situation of factories near to them. The figures show, however, that successful yields can be obtained on these soils in Holland, though the specially favourable circumstances in that country should be borne in mind, since attempts which are successful there might not yield the same result elsewhere.

In Germany, statistics of the yield of sugar beet in the various provinces do not appear to have been officially recorded before the war, and post-war figures have been, until recently, so influenced by war-time conditions that they do not reflect the full extent of the yields possible. Fensch and Sagawe have, however, provided information as regards the yields from 1910 to 1913 on a large number of farms in Silesia, Saxony, and Mecklenburg, taken from accounts kept by the Agricultural Societies at Breslau, Halle, and Rostock respectively:

TABLE XVII. *Yield of Beet on Farms in Silesia, Saxony, and Mecklenburg, pre-War.*

	1910-11.		1911-12.		1912-13.		1913-14.		3-yr. average, 1910-11 to 1912-13.	
	No. of farms.	Yield per acre. Tons.	No. of farms.	Yield per acre. Tons.	No. of farms.	Yield per acre. Tons.	No. of farms.	Yield per acre. Tons.	No. of farms.	Yield per acre. Tons.
Silesia ¹ . . .	111	13.91	138	7.57	174	13.11	122	13.95	423	11.52
Saxony ² . . .	43	10.12	43	5.90	43	10.88	—	—	129	8.96
Mecklenburg ³ . .	16	11.31	24	8.61	24	11.31	—	—	64	10.40

¹ 60 per cent. of the farms in the year 1910-11 are represented in the succeeding years.² The same farms for all three years.³ The 24 farms in 1911-12 and 1912-13 are the same. The 16 farms in 1910-11 are included in the subsequent years.

The effect of the serious drought in 1911 is seen in the very decreased yields obtained in that year. Leaving out this year, it will be observed that the highest average yield is 13.95 tons per acre on 122 farms in Silesia in 1913-14, which must be considered as very good. In Saxony, which is, even more than Silesia, a very important beet-growing province, the best average yield was 10.88 tons on 43 farms in 1912-13. The highest in Mecklenburg was 11.31 tons, which was secured both in 1910-11 and in 1912-13.

These figures must be considered as very good results, for the German authors state in the introduction to their study that 'those farms connected with the book-keeping society were the best organized and best managed. . . . The farms mentioned . . . are far above average.' In post-war years the accounts of the Agricultural Book-keeping Societies (*Landwirtschaftliche Buchführungsergebnisse*), which have been made available for the purposes of an inquiry into German industries (including agriculture), provide much information regarding yields of sugar beet in various districts. The figures given in Table XVIII have been compiled from this source, and show the yields in 1924-5 and 1925-6 on farms in Silesia, North Germany (which includes Mecklenburg), Middle Germany (including Saxony), and on all the accounting farms growing sugar beet.

In addition to the district figures, the first part of the table is divided to show the yields obtained on different types of farms.

As between the three districts represented, the Silesian and Mid-German farms show the highest yields, the average of the North German farms being considerably lower than on those in the first mentioned districts. Soil has evidently some bearing on these results, as the North German farms contain a large proportion of grain farms having middle-class and poor soils.

It will be noticed also that, in point of yield, the sugar beet farms usually come first, followed by the potato farms and grain farms (good soils). The grain farms (middle soils) obtained yields of 9.5 tons and 10.3 tons per acre, while the same type of farm with poor soils only secured an average yield of 9.0 tons per acre in both years. The yields on this type of farm are 3.0 tons and 2.7 tons lower than those on the sugar beet farms in 1924-5 and 1925-6 respectively. While it appears that the sugar beet farms, the potato farms,

TABLE XVIII. (a) *Yield of Sugar Beet per acre in certain districts of Germany and on various types of Farms in 1924-5 and in 1925-6.*

District.	Sugar Beet farms.		Potato growing farms.		Grain farms.				Fodder growing farms.		All accounting farms.	
	No. of farms.	Yield. Tons.	No. of farms.	Yield. Tons.	Good soils.	Middle soils.	Poor soils.		No. of farms.	Yield. Tons.	No. of farms.	Yield. Tons.
Silesia:												
1924-5	74	11.2	38	10.5	42	11.4	57	9.5	11	8.7	251	10.5
1925-6	77	13.0	41	12.1	42	12.1	64	11.4	14	9.3	272	11.9
North Germany:												
1924-5	16	10.3	18	9.7	27	9.3	70	8.1	21	8.2	165	8.5
1925-6	28	10.5	24	10.5	39	9.9	97	8.5	33	7.6	238	9.3
Mid-Germany:												
1924-5	156	12.6	22	11.8	45	11.1	75	10.4	28	10.6	336	11.6
1925-6	172	11.0	30	10.5	48	11.6	94	10.8	35	10.7	391	10.7
All accounting farms:												
1924-5	277	12.0	91	10.6	125	11.0	219	9.5	—	9.0	934	10.6
1925-6	303	11.7	110	11.4	154	11.5	276	10.3	—	9.0	1,118	11.0

(b) *Distribution of Sugar Beet Yields on German Farms.*¹

Year.	GROUP YIELDS.							
	6-8 tons per acre.		8-10 tons per acre.		10-12 tons per acre.		Over 12 tons per acre.	
	No. of farms.	Percentage of total.	No. of farms.	Percentage of total.	No. of farms.	Percentage of total.	No. of farms.	Percentage of total.
1924-5	107	11.46	171	18.31	385	41.42	271	29.01
1925-6	70	6.26	198	17.71	517	46.24	333	29.79
							No. of farms.	Per cent.
							934	100.0
							1,118	100.0

¹ As the proportion of farms in each yield group is compiled from yields on *groups* of farms, discrepancies would occur between the figures shown and those based on a study of *individual* farm yields had those been available. It is not thought, however, that the proportion of farms in the various yield groups would alter materially.

and grain farms (good soils) have a larger proportion of their land under sugar beet, the differences in yield between these and the other types mentioned must be regarded as being mainly due to the variations in soil qualities rather than to an extended cultivation of sugar beet.

In the second part of the table the farms are distributed into four groups distinguished by yield, a frequency of approximately 2 tons per acre being chosen. It is instructive to find that only 11.46 per cent. of the farms in 1924-5 and 6.26 per cent. in 1925-6 have yields as low as between 6 and 8 tons. The greatest concentration of farms is found between 10 and 12 tons per acre, 41.22 per cent. and 46.24 per cent. being found in this range in the respective years.

As regards the yields in the various districts of France, the following table is of interest:

TABLE XIX. *Average Yields in the chief Beet Growing Districts of France in 1912 and 1913.*¹

<i>Department.</i>	<i>Yield per acre.</i>	
	1912.	1913.
	<i>Tons.</i>	<i>Tons.</i>
Aisne	9.96	9.96
Nord	12.95	11.95
Oise	10.84	9.56
Pas-de-Calais	12.35	11.16
Seine-et-Marne	10.76	11.16
Somme	11.36	10.28
Above six districts	11.28	10.58
France	11.28	9.49

The area of beet grown in these departments, which are situated in the north of France, represent approximately 80 per cent. of the total area devoted to the crop in that country. The average yields range from 9.96 to 12.95 tons per acre in 1912, and from 9.56 to 11.95 tons per acre in 1913. The Department Nord comes out best in both years, and is followed by the Department of Pas-de-Calais. Both these districts will be familiar to all who had experience of the war in France.

The soil in these and the other districts included above is mostly a heavy loam over chalk, and it is on this that most of the beet is grown. Heavier soils are always reported as

¹ From official statistics.

giving the best yields. Evidence was forthcoming that yields had now recovered from war-time effects, and yields of 9.88 tons to 13.83 tons per acre, with an average of 11.07 tons, were reported at Eppeville (Somme) and Montescourt (Aisne) near St. Quentin, and an average yield of 10.28 tons per acre at Escaudœuvres (Nord) near Cambrai.

In the pre-war year 1912 only 7 (or 21 per cent.) out of 34 French departments in which sugar beet was grown, and in the following year 6 (or 17 per cent.) out of 35 departments, reported average yields lower than 8 tons per acre. The departments reporting these low yields are, however, mostly situated in the south-east of France in the Rhone basin, a district which is not important from a beet-growing point of view, and where climatic conditions are entirely different from those in this country. Important beet-growing departments reporting yields of between 8 and 10 tons were Aisne and Marne in 1912, and Aisne, Marne, and Oise in 1913, but in all these cases the average yields were nearer to 10 tons per acre.

Figures of the yields since 1919 of the nine provinces in Belgium are shown in Table XX.

The most important beet-growing province is Hainaut in the south-west, where an average area of 45,709 acres is grown, but the other provinces also contain a fair quantity of beet, the only exception being Antwerp, which only grows slightly over 1,000 acres. The crop is therefore well distributed over the country and is grown on a variety of soils. In West Flanders the soil is a sandy clay ('région limoneuse'), and there the best average yields are obtained, the figure for the 8 years 1919-26 being equal to 13.26 tons per acre. The sandy region of East Flanders also obtains very good yields. The other districts show averages at a lower level, namely between 10 and 11 tons per acre. In the Hesbaye (which includes parts of Liège, Namur, and Brabant) and in Hainaut, where together the greatest concentration of beet growing is found, the soil approximates more to the French type, being a good working loam towards the heavy side.

The Agronome de l'État for the province of Hainaut put the average farm yield at between 11.84 and 15.78 tons per acre. In the same province a good farmer with good soil gave his average yields as between 11.85 and 13.83 tons per acre. In a bad year he might drop to about 10 tons, and he stated that in other places in the same district the yields ranged from 7.91 to 9.88 tons per acre.

TABLE XX. *Yields per Acre in Belgium, by Provinces.*¹

	Antwerp.	Brabant.	Flandres Oc.	Flandres Or.	Hainaut.	Liège.	Limburg.	Luxembourg.	Namur.
	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.	Yield. Tons.
1919 .	12.91	9.70	13.33	12.65	9.85	10.47	9.20	—	9.93
1920 .	12.36	10.07	13.43	12.17	10.79	10.45	10.36	—	10.89
1921 .	15.91	9.43	10.60	13.01	9.51	9.40	10.01	—	10.45
1922 .	10.76	10.61	13.61	13.83	11.36	10.94	9.32	13.95	10.89
1923 .	13.93	10.51	13.02	12.71	11.27	10.20	10.09	11.95	11.09
1924 .	10.02	11.28	14.28	12.86	12.07	12.03	12.14	11.27	11.49
1925 .	11.99	11.76	13.91	13.87	10.75	13.02	11.78	10.29	10.91
1926 .	12.73	9.29	12.87	9.24	14.41	10.37	9.67	9.96	9.81
Average 1919-26 .	12.93	10.41	13.26	12.86	10.83	10.93	10.44	10.84	10.76

¹ From official statistics.

As giving some indication of the capacity of these deep loam soils, a large farmer near Gembloux in the province of Namur obtained 15.42 tons in 1925 when the district average was 12.5 tons, and in the following year secured 12.65 tons when the average for the district was 9.48 tons. The yield of 15.42 tons was, however, the best yield he had ever had in his farming experience. Even greater yields were reported by the Agronome at Gembloux, who said that the small growers with 1 hectare (about $2\frac{1}{2}$ acres) of beet obtained yields of 15.81 tons to 17.78 tons to the acre, whereas the average of the large farmers was 11.12 tons.

In so far as the countries visited are concerned, it may be said that every effort is made to obtain good yields, and the appearance of the beet fields abroad is evidence of the close attention paid by farmers generally to the crop. Those fields seen by the writers in 1926 and 1927 were very uniform and regular, and the closeness of the plants on the ground gave the impression that the land was being utilized to the fullest extent. As having an important bearing on the yield, it may also be stated that, on the Continent, beets are not generally grown on dirty land. The land is clean before it is planted, and the frequent hoeings and stirring during the summer ensures that the crop remains free from weeds throughout the whole of its growing period.

(b) *Sugar Content*

Except for Holland, statistical information giving the sugar content of beets is not available. In Holland the average sugar content of all roots worked in each campaign is published in the official statistics. The figures for the years corresponding to those shown in the previous chapter on yield are given in the following table, together with the amount of sugar per acre which the combined yield and sugar content represents:

TABLE XXI. *Sugar Content and Sugar per Acre in Holland*

Year.	Average sugar content. Per cent.	Total sugar per acre. Tons.
1901 . . .	15.1	2.22
1902 . . .	15.5	1.70
1903 . . .	14.5	1.39
1904 . . .	16.5	1.95
1905 . . .	15.5	2.09

<i>Year.</i>	<i>Average sugar content. Per cent.</i>			<i>Total sugar per acre. Tons.</i>	
1906	.	.	.	16.2	2.07
1907	.	.	.	15.9	1.87
1908	.	.	.	16.8	2.18
1909	.	.	.	15.5	1.67
1910	.	.	.	16.5	1.90
1911	.	.	.	15.57	2.37
1912	.	.	.	16.65	2.22
1913	.	.	.	16.55	1.82
1914	.	.	.	16.30	2.05
1915	.	.	.	16.50	1.99
1916	.	.	.	16.85	1.78
1917	.	.	.	16.68	2.12
1918	.	.	.	16.18	2.09
1919	.	.	.	16.76	1.88
1920	.	.	.	17.28	1.97
1921	.	.	.	17.22	2.28
1922	.	.	.	17.33	2.24
1923	.	.	.	15.75	1.60
1924	.	.	.	17.00	2.22
1925	.	.	.	17.22	2.31

These figures show that there has been a considerable increase in the sugar content of the beets since 1901. In the figures for the decade 1901-10 the sugar content was under 16 per cent. in six out of the ten years, whereas in the following decade all years, except one, show a sugar content lying between 16 and 17 per cent., the exception being that of the last year of the decade, which showed for the first time in 20 years a yield of over 17 per cent., viz. 17.28 per cent. From 1921 to 1925 four out of the five years show a sugar content of 17 per cent. and over. In 1923, which was a wet and cold year, the sugar content fell to 15.75 per cent.

It will be observed also that the total sugar yield per acre has also been increasing, and in recent years is well over 2 tons to the acre.

As stated above, no comparable figures are available for the remaining countries. In Germany, in recent years, the sugar content is believed to have averaged between 16 and 17½ per cent. In one factory operating in Saxony the average sugar content of the beets worked was 17.65 and 17.58 per cent. for the years 1924-5 and 1925-6 respectively. The

growers supplying this factory farmed some of the best beet land in Germany.

In Belgium the writers have been informed that during the years 1901 to 1926 the sugar content is estimated to have ranged between 14 and $18\frac{1}{2}$ per cent. In the Tournai district it is stated to vary between $16\frac{1}{2}$ and 18 per cent., with exceptional cases of $18\frac{1}{2}$ or 19 per cent.

No information was obtained in relation to this question in France.

VII. BY-PRODUCTS

(a) *Tops and Leaves*

THE supply of by-products from the sugar beet industry has an important influence on the economy of the agriculture in those districts of the Continent where the crop is extensively grown. The crowns and leaves left on the farm after the saleable part of the sugar beet crop has been sent to the factory come first in order of importance. These crowns and leaves are important agriculturally, either as a manure or as one of the bulky feeding stuffs of the farm.

The amount of tops and leaves available varies a good deal, being dependent to a considerable extent on the weight of the total crop (root and leaves), which is in turn influenced by soil and manuring. Nitrogenous manuring especially plays an influential part in the supply. In Holland it is stated by Zwagerman that without nitrogenous manuring tops and leaves will amount to 50 per cent. of the weight of beets, while with liberal applications they will attain to 70 per cent.

The ratio of top to root varies also according to the supplies of other fodder available for winter feeding of stock, because in poor fodder years more top is cut off than in normal seasons. Again, in some districts where winter fodder is of extreme importance, varieties of beet are grown in which the proportion of leaf to root has been developed by breeding and selection. Further, certain seasons favour the growth of leaf more than others.

Notwithstanding these variable factors, it was possible to get some very useful estimates of the quantities produced in the various countries. In Holland, in the province of North Brabant, yields of tops and leaves were estimated from 6 to 8 tons per acre, and in the same province near Breda it was said that they were equal to the weight of the roots, namely about 12 tons to the acre.

Further west, in Zeeland, the yield was given as 11 tons, or nearly two-thirds of the weight of the washed beets. In the north, in Friesland, estimates of nearly 8 tons were mentioned. Zwagerman states that investigations showed an average yield of 27,000 kilograms per hectare ($10\frac{3}{4}$ tons per acre), with variations from 20,000 to 40,000 kilograms per hectare (8 to

16 tons per acre). These figures presumably are for the whole of the country. As the officially recorded yield of washed roots is in the region of $12\frac{1}{2}$ tons, the average weight of tops and leaves recorded in the leaflet is equal to 86 per cent. of the weight of the roots.

In Germany estimates received from farmers were from 6 to 8 tons per acre, but Remy, writing doubtless of the Rhineland sugar beet district, puts the yield as high as 10 tons on average. The Verein der Deutschen Zucker-Industrie, however, gives the average yield for Germany as about $6\frac{1}{2}$ tons per acre. Roemer states that they amount to from 50 to 70 per cent. of the weight of beet, which on present yields in Germany would give a weight of tops and leaves of from 5 to 7 tons.

In Belgium, in the province of Hainaut, the Agronome de l'État estimated the average yield as from 6 to 8 tons. In the Hesbaye a farmer estimated the tops on average as being equal to the weight of the roots (11.16 tons) and in 1926 he put them higher. Dubois estimated the average yield in Belgium as 8 tons to the acre.

In northern France rather lower figures were obtained.

Using Zwagerman's figure for Holland, those of the Verein der Deutschen Zucker-Industrie for Germany, those of Dubois for Belgium, and an average yield of $6\frac{1}{2}$ tons for France, the following is an estimate of the total quantities of tops and leaves which would be produced in the four countries, based on the 1925 acreage:

TABLE XXII. *Estimated Yield of Tops and Leaves.*

	<i>Acres of beet.</i> <i>1,000 acres.</i>	<i>Yield per acre.</i> <i>Tons.</i>	<i>Total quantity</i> <i>produced.</i> <i>Tons.</i>
Holland . .	163	$10\frac{3}{4}$	1,752,250
Germany . .	995	$6\frac{1}{2}$	6,467,500
Belgium . .	178	8	1,408,000
France . .	529	$6\frac{1}{2}$	3,438,500
	1,865	7	13,066,250

That this by-product of the sugar beet crop forms an important auxiliary potential supply of fodder cannot be doubted. The actual quantities of tops and leaves as cut off in the fresh state probably considerably exceeds these estimates, which doubtless allow for a certain amount of wilting and wastage to take place before collection.

Before attempting to assess the value of this by-product it is essential in the first instance to discuss the methods of use on farms on the Continent. Occasionally cases were met with where, owing either to the dearness of labour, or to the dearth of it after harvesting, or to the plentiful supply of other bulky fodder, or to the system of farming which did not involve the carrying of much winter stock, the tops and leaves were ploughed in. Roemer considers this method as very wasteful, but it is, of course, not without its advantages. Six to eleven tons of tops and leaves is a considerable dressing of green manure, which, since all charges of topping are allocated to the beet account, is obtained for nothing. Further, there are no cartage or spreading expenses as would be attached to a similar dressing of farmyard manure. Finally, by ploughing in, the land can be prepared immediately for the succeeding crop. An experiment on oats quoted by Roemer gives the increase due to a dressing of beet leaves at 6 cwt. of grain and $7\frac{1}{2}$ cwt. of straw per acre, though the advantage would not usually be so great.

This method of disposal is, however, very exceptional. The Continental farmer estimates on the supply of tops and leaves, together with pulp from the factories, for the main part of his succulent winter fodder, and the general rule is to consume them by live stock. A considerable amount of care is therefore exercised at the harvesting of the beet to see that as little damage as possible is done to the tops and leaves, and to keep them clean.

Actual methods of consumption vary. Folding by sheep was carried on to some extent in Zeeland in Holland, and in Germany sheep were allowed to run over the fields after the major part had been carted off. Folding is not generally favoured, on the ground that it poaches the heavier lands badly, and also that a considerable amount of fodder is wasted by being trampled in. In dairying districts fresh tops and leaves are carted on to pastures, where the cows consume them, and some are similarly carted to young stock. Immediately stock go indoors, the tops and leaves are carted to the houses and fed as the root ration. Similarly in districts where fattening of cattle prevails they are carted to stock in the yards. The practice of feeding fresh tops and leaves is carried right through the beet harvesting season, roughly October, November, and early December, and very often no other kind of food is fed. This method is considered the most

profitable, as the least cost is incurred, the waste of food value is small, and the digestibility of the food is at its highest. The amount so used varies, but on one farm at least one-quarter of the total was consumed fresh. Zwagerman recommends the following rations, using a preponderating weight of tops and leaves:

(a) Milch-cows of a live weight of $11\frac{3}{4}$ cwt. and a milk yield of $2\frac{1}{2}$ gal. daily:

9 lb.	.	.	.	.	meadow hay.
1 "	.	.	.	.	wheat chaff.
1 "	.	.	.	.	oat chaff.
$2\frac{1}{4}$ "	.	.	.	.	ground-nut cake.
90 "	.	.	.	.	beet tops and leaves.

(b) Store cattle, 1,100 lb. live weight:

$4\frac{1}{2}$ lb.	.	.	.	.	meadow hay.
$6\frac{1}{2}$ "	.	.	.	.	oat straw.
1 "	.	.	.	.	cotton-seed meal.
13 "	.	.	.	.	beet tops and leaves.

(c) Young growing cattle of an average live weight of 880 lb. intended for milking and fattening:

$2\frac{1}{4}$ lb.	.	.	.	.	meadow hay.
$6\frac{1}{2}$ "	.	.	.	.	oat straw.
1 "	.	.	.	.	cotton-seed meal.
90 "	.	.	.	.	beet tops and leaves.

(d) Pigs at the commencement of the fattening period, per 110 lb. live weight:

$15\frac{1}{2}$ lb.	.	.	.	.	beet tops and leaves.
3 "	.	.	.	.	peasemeal, maize meal, barley meal.

Abundant feeding with tops and leaves may lead to diarrhoea, symptoms of poisoning and bone-softening, and Zwagerman gives a warning against feeding with tops gathered in the morning dew or in very wet weather. It is always advisable, he says, to increase the ration gradually, and dry fodder such as hay or straw is recommended as an addition to a tops-and-leaves ration, although it must be confessed that, on several occasions, the writers saw stock being fed on tops and leaves alone. To counteract the cathartic effect of the feeding of tops and leaves, he also recommends an addition of 20 to 45 grammes (but not more) of phosphate of lime (but never chalk, as this aggravates the

trouble), especially if the leaves are dirty. Roemer lays great stress on the fact that the leaves should be clean. 'Sometimes', he says, 'as much as 20 per cent. of sand is on the leaves when given to animals. This contains many bacteria which give rise to diarrhoea and even poisoning.'

Most of the earliest harvested tops and leaves are fed fresh, but in many cases, simultaneously with direct consumption, they are being carted to the side of the field, or to the homestead for making into silage. This is almost a universal practice on the Continent. In Germany two-thirds of the harvest of beet leaves is preserved in this manner. In Germany, Belgium, and France, tops and leaves are mixed with wet pulp from the factories, and a usual proportion is 3 of tops and leaves to 1 of pulp, in layers of 2 to 3 ft. of tops and leaves and 8 in. of pulp. In Holland similar methods are carried out, but in some districts it is more popular to make ensilage of the tops and leaves separately from the pulp, as the latter, when ready to be fed, can be mixed with meals, whereas tops and leaves can only be fed separately.

On large and small farms alike it is customary to make the silos in the ground, and no special towers are in evidence.

A typical example of the construction of a pit silo on the Continent is given by Zwagerman:

The pit should not be made too wide, e.g. 6 ft. 6 in. to 8 ft. A narrower pile will cool more rapidly, thus reducing the loss. The length of the pit is optional, so long as it is borne in mind that it must be possible to complete the filling in two, at the utmost three, days. The depth of the pit is immaterial, if only care is taken that the bottom shall be well above the highest level of the ground-water. The bottom of the pit should be given a slight fall, whilst it is advisable to provide drain-pipes at the lowest end so as to form a drainage channel. The longitudinal sides should be cut straight and the short sides obliquely, to enable a loaded cart to be driven over the pile. Bottom and side walls are to be covered with a very thin layer of straw. The pit should preferably be made in such a way that it will be easy to drive round it on all sides and successive carts to be unloaded on different sides.

The ensiling may be done both in dry and rainy weather. It is very important that when doing so the leaves shall be as fresh as possible, that the fodder shall be gathered together in as clean a manner as possible, and that the mass during the filling shall be trodden down as firmly as possible. As soon as the pile has reached a sufficient height, about from 6 ft. 6 in. to 13 ft. above the ground, according to the depth of the pit, the latter may be covered over

with a very thin layer of straw, which serves to obtain a division between fodder and soil. On the first day $9\frac{1}{2}$ in. of soil is placed direct thereon and on the following day 23 in., in such a way, of course, that any irregular sagging is avoided; whilst at the sides a covering of from 16 in. to 19 in. is provided. To enable rain-water to run off, it is further recommended to make a furrow on the pile for drainage. A necessary condition for proper success is the total exclusion of air. To obtain this, no straw layers or only very thin ones should be employed, and firm treading, rapid filling, heavy ballasting, and the prevention of sagging should be observed.

On some German farms potato haulms were used for the bottom layers of the pit. Considerable losses of food material occur in the making of silage. Remy states that 'the loss in course of preparation is not more than 10 per cent. of the crude albuminoid and starch, if care is taken. But this is dependent on the silos being watertight and on the sap being safely stored, as well as on the silos being airtight.' As most of the pits are of a primitive nature, the loss is likely to be very much higher. Garckesays 'the loss of weight in the making of silage is 30 per cent.', viz. that 6 tons of tops and leaves will produce 4.2 tons of edible silage per acre. Zwagerman states that 'the loss in weight on an average is $29\frac{1}{2}$ per cent., while 3 per cent. of the fodder is unfit for use, and therefore that $10\frac{3}{4}$ tons of tops and leaves will yield only $7\frac{1}{4}$ tons of silage per acre. In terms of food values the original tops and leaves will contain 261 lb. of digestible protein and 1,715 lb. of carbohydrates per acre, while the resulting silage will only contain 127 lb. and 1,057 lb. of digestible protein and carbohydrates respectively.' It will be noticed that the loss is heaviest on protein, which is the most valuable part of the food. Roemer puts the loss in stacks or porous pits at 50 per cent., in clay pits 40 per cent., and in cemented pits or good silos at 20 to 25 per cent., while the digestibility of the silage is not so high as in fresh leaves.

The loss in the making of silage is therefore very great. But on the Continent the utility of the process is based on the fact that the silage is the main winter food, and, therefore, to retain the tops and leaves in a form in which they will keep, the making of silage, though it means severe losses of food material, is a necessary essential of the system of farming. The only factor to be considered is the question of reducing the losses.

Zwagerman gives the following as suitable rations with pit silage made from tops and leaves:

(a) Milch-cows of a live weight of 12 cwt. and a yield of milk of 2 gal. per day:

11 lb.	.	.	meadow hay.
1 "	.	.	oat chaff.
1 "	.	.	wheat chaff.
2 $\frac{1}{4}$ "	.	.	American linseed meal.
3 $\frac{1}{4}$ "	.	.	ground-nut cake.
44 "	.	.	mangolds.
55 "	.	.	silage.

(b) Store cattle of 11 cwt.:

4 $\frac{1}{2}$ lb.	.	.	meadow hay.
1 "	.	.	hay from grass cut along the banks of ditches.
2 $\frac{1}{4}$ "	.	.	chopped pea straw.
$\frac{1}{2}$ "	.	.	wheat chaff.
$\frac{1}{2}$ "	.	.	oat chaff.
2 $\frac{1}{4}$ "	.	.	ground-nut cake.
7 $\frac{1}{2}$ "	.	.	second quality wheat.
33 "	.	.	mangolds.
35 "	.	.	silage.

(c) Growing young cattle of an average weight of 8 cwt. intended for milking and fattening:

6 $\frac{1}{2}$ lb.	.	.	meadow hay.
4 $\frac{1}{2}$ "	.	.	chopped oat straw.
3 $\frac{1}{4}$ "	.	.	chopped pea straw.
22 "	.	.	pulp (wet).
33 "	.	.	mangolds.
2 $\frac{1}{4}$ "	.	.	cotton-seed meal.
35 "	.	.	silage.

(d) Pigs at the commencement of the fattening period per cwt. live weight:

13 lb.	.	.	silage.
3 "	.	.	linseed meal, peasemeal, maize meal, barley meal.

The wastage factor in making silage has led to the search for improved methods of preserving the tops and leaves. The tower silo and cemented pit silos are advocated, by which the loss may be reduced to 20-25 per cent. Further improvements are suggested by washing the tops and leaves so as to free them from dirt. After washing, the tops and leaves

are chaffed by machinery. Washing and cutting in Germany was said to cost about 1s. per ton of leaves. Freeing the tops and leaves from dirt reduces the risk of adverse bacterial action in the silo, and chaffing enables the material to be packed adequately, with the result that conditions for the making of good silage are more easily fulfilled. Tower silos and washing and cutting machines are expensive, and the method is only economically possible on the large farms.

In parts of Silesia small holders, who obtain part of the beet tops and leaves as payment for their work at harvesting for large farmers, dry these tops and leaves in the open air.

Artificial drying, after washing and cutting up, has been experimented with, and is now considered to give satisfactory results. The loss of nitrogenous material which occurs in making ordinary silage is much reduced. Roemer puts the food value of the dried material from an acre of tops and leaves as equal to a crop of oats, and the cost of drying in Central Germany at from 154 to 170 marks per hectare (not including carting), which is equal to about £3 to £3 10s. 0d. per acre. As in the case of the introduction of tower silos, this is only a proposition which can be considered by large farmers. Co-operative action may overcome this difficulty by the establishment of drying stations in suitable areas.

Zwagerman also mentions another method of dealing with the by-product. This is to cut the leaves from the tops, the latter being piled in small heaps in the fields, while the leaves are ploughed in. This practice is very costly in labour.

The general position as regards utilization may therefore be summed up by saying that only in isolated cases are the tops and leaves ploughed in, and that the general practice is to feed them. This is partly done in a fresh state and partly in the form of silage, the whole, along with pulp from the factories, forming the main supply of the winter bulky fodder ration outside hay and straw.

The value of the tops and leaves will therefore be dependent on the methods of utilization, but as the general practice is to consume them, the value of this by-product will approach nearer to that of its food content than to its manurial constituents, and will generally lie between the value as fresh fodder and as silage.

Some estimates are given below of the value of the by-product as compared with other crops, and in terms of animal keep:

HOLLAND.

Director of Agriculture: Overijssel. Tops and leaves are excellent food. They are equal to the hay crop of the same area according to some of the farmers, and this is an advantage of sugar beet as compared with potatoes.

Zwagerman says: (1) 2 cwt. of tops and leaves for feeding (fresh) are equal to 2 cwt. of mangolds + $4\frac{1}{2}$ lb. cotton seed meal + 1 lb. maize meal, and also equal to 264 lb. tops and leaves silage + $4\frac{1}{2}$ lb. cotton seed meal; (2) 2 cwt. of ensilage from tops and leaves are equal to $1\frac{3}{4}$ cwt. mangolds and $2\frac{3}{4}$ lb. cotton seed meal + 1 lb. barley meal.

GERMANY.

Remy says a hay harvest of 167 lb. digestible protein and 1,320 lb. carbohydrates per acre is not much more profitable than a tops-and-leaves harvest giving 101 lb. digestible protein + 1,408 lb. carbohydrates per acre. By an addition of 176 lb. of albuminoid oil cake, a moderate beet harvest is brought up to the value of a hay harvest.

BELGIUM.

A farmer in the province of Namur says one acre of beet tops and leaves (fresh) will fatten one beast.

FRANCE.

A farmer in the Aisne department stated that one acre of beet tops and leaves will keep 200 sheep for a day.

Money values were placed on this by-product in several cases, and the figures are given together with the yields in Table XXIII.

From these data it is impossible to state with any precision the average values in the various countries. It is sufficient to emphasize that they are considered an important source of revenue from sugar beet growing and that their value can be approximately determined by considering the uses to which they are put, based on current manurial and food values.

(b) Pulp

Pulp is also a very important by-product of sugar beet in the eyes of Continental farmers. In Holland, Belgium, and France it is mostly turned out in the wet state from the factories. In Germany, however, modern practice is now to supply wet pulp until about the middle of November, after which the drying plants are set to work, and to the end of the

TABLE XXIII. *Estimates of Yield and Value of Tops and Leaves.*

<i>Country and district.</i>	<i>Yield of tops and leaves per acre. Tons.</i>	<i>Basis of valuation.</i>	<i>Value per acre. s. d.</i>
<i>Holland:</i>			
Friesland . . .	—	As food generally	80 0
Overijssel . . .	—	„ „	100 0
Zeeland . . .	11.0	„ „	50 0
<i>Germany:</i>			
Harz . . .	13.0 ¹	{ As manure	{ 16 0 to
		{ As food (fresh tops and leaves)	{ 20 0
			{ 40 0 to
			{ 56 0
General . . .	6.0 ²	As silage	84 0
„ . . .	6.3	As generally utilized	{ 25 0 to
			{ 40 0
<i>Belgium:</i>			
Namur . . .	—	As food generally	34 3 ³
„ . . .	7.9 ⁴	{ As manure	{ 18 10
		{ As food (fresh tops and leaves)	{ 36 10
Hainaut . . .	—	As manure	{ 27 5 to
			{ 32 0
		As food generally	64 0
„ . . .	6.0-7.9	„ „	45 8
General . . .	—	As generally utilized	22 10

season the remainder of the pulp is dried. In this way the farmer obtains wet pulp to ensile with the tops and leaves, or to feed fresh to his stock, while the provision of late winter and early spring food is provided by means of the dry pulp.

Contracts usually provide that growers shall receive an amount of wet pulp equivalent to a certain proportion of the washed beets delivered by them to the factory. This proportion varies from 45 to 60 per cent. of the beets. It is about 45 to 50 per cent. when the cossettes are pressed after they leave the diffusion batteries, and reaches the higher limit of 60 per cent. when the cossettes are supplied without having excess moisture taken out. The practice of pressing

¹ Containing 88 lb. nitrogen, 103 lb. K₂O, and 24 lb. K₂O₅.

² Making 4 tons of silage per acre.

³ Smallholders in this district receive tops and leaves as payment for the work of harvesting. 34s. 3d. represents the value of the work.

⁴ Manurial constituents, 56 lb. nitrogen, 62 lb. K₂O, 18 lb. P₂O₅.

the pulp is certainly an advantage for the purpose of reducing rail and other transport charges.

In Germany, where dried pulp is becoming more popular, the equivalent of about 5.5 per cent. of the beets delivered is supplied as dried pulp, though in some factories the proportion was as high as 10 per cent. (of fire-dried pulp containing 10 per cent. moisture).

Where the practice is to supply both wet and dried pulp, farmers must notify the factories before the campaign begins in what proportions, wet or dry, they require their supplies.

As regards the financial aspect of the contract in relation to pulp, it seems that in Holland it is more general for the factories to charge for the pulp, while the farmer usually pays carriage from the factory to his local station. In some of the co-operative factories the price charged is based on the selling price of negotiated pulp; that is, surplus pulp not taken up by the farmers. The average price obtained for the whole of this negotiated pulp at the factory thus determines the price to be charged to the farmer. The price has varied considerably, being as high as 8*s.* 4*d.* per ton and as low as 3*s.* 4*d.* per ton of wet pulp. According to the Dutch official statistics, the average price of wet pulp in 1925 was 8*s.* 4*d.* per ton, and in 1926 7*s.* 6*d.* per ton delivered at buyers' station.

In Germany the pulp is usually handed over free to the farmers. The price of beet is, of course, no doubt adjusted accordingly, but the practice is favourable, because it induces growers to take up supplies. In the case of dried pulp this again is supplied free, except that growers pay the cost of drying. In one case this was stated to be 4*s.* 8*d.* per ton of dried beet. Again, it is customary for the farmers to pay the carriage to their local stations. Wet pulp is considered to be worth about 8 to 10 marks per 1,000 kilos or 8*s.* to 10*s.* per ton. Dried pulp is usually worth 100–120 marks per 1,000 kilos or £5 to £6 per ton.¹ These figures approximate to the market price of the surpluses from the factories. Growers requiring supplies greater than is allowed them under the contract are given more favourable terms than the market price.

In Belgium it is the usual practice to negotiate prices for beet so that farmers get the pulp free, and owing to the State taxes on contracts and receipts, rail charges to growers' stations are also paid by the factories in order that the whole of the business of selling beet, transporting it, the selling

¹ Statement of Verein der Deutschen Zucker-Industrie.

of beet pulp and its transportation is included in one contract.

In 1926 wet pulp was worth on the market about 60–70 francs per 1,000 kilos or 6s. 10d. to 8s. per ton. At Tirlemont beet growers received *supplies over the 60 per cent. allowance*, which is given at that factory, at a price corresponding to 4s. per ton, and the price for the customary allowance is probably based on a still smaller figure, so that it appears that considerable concessions are given to growers in the supply of the pulp.

In France contracts with privately-owned companies include an arrangement by which it is usual for the farmers to pay for the pulp as well as for the carriage. Prices in 1925–26 in one factory were 14 francs per 1,000 kilos, and in 1926–27 in two other factories were 22 francs and 25 francs for a similar quantity. These prices are difficult to convert into English currency owing to the instability of the franc, but they might be considered very approximately as equal to 3s.–4s. a ton, which appears to be a considerable concession on market values.

All contracts with beet growers, especially where private companies are concerned as owners of factories, contain provisions as to supply, price, and conditions under which pulp is supplied.

These provisions usually deal with:

1. *Quantity* to be supplied, price (if any), conditions as to when the supply is to be delivered, and the payment of carriage. These conditions are usually subject to agreements between farmers' and factories' representatives before the contract is prepared. Pulp is usually loaded at factory expense. If rail carriage is free at growers' stations, growers who collect pulp at the factory are often given a small payment to represent the cost saved to the factory. Surplus supplies are at the disposal of the factories, and growers may obtain part or whole of this surplus according to the resources of the factory and on terms to be determined by the company. At one factory in France, however, the surplus is sold at commercial price, which is determined by a conference of growers and manufacturers held in the first fortnight of October. In some cases of surplus supplies, the grower who obtains them must guarantee to supply all the beet he grows to the particular factory. This clause appears when competition for beet supplies is keen.

2. *Delivery.* To relieve congestion at factories, growers must take up their supplies of pulp, and it is often stipulated that one-third be taken in each of the months of October, November, and December. Other contracts lay down that supplies are to be taken *pro rata* to beets received at the factory, and in some the supplies must be taken not later than three weeks after beets are delivered. Growers failing to take supplies of pulp according to schedule may be warned by letter, and if within four days of dispatch of the letter they do not take up delivery, their right to the full percentage may be lost.

3. *Quality.* Clauses are inserted to provide some safeguard to the growers as to the quality of pulp. These are often quite general, indicating that the pulp must be sound, wholesome, unadulterated, and marketable. In the Tirlmont factory contract the pulp must contain at least 8 per cent. dry matter, and the analysis is made by the factory chemist in conjunction with the growers' representative. If the pulp does not contain this proportion of dry matter there must be furnished additional pulp according to arrangements previously made between growers and factory.

4. *General.* It is also a general rule of all contracts relating to pulp that it must be consumed on the farm of the grower. Transactions, even in the case of surplus pulp, are not allowed with third parties.

The general impression produced by a study of the beet sugar industry on the Continent is the realization of the fact that the full benefits of the industry are not obtained unless the pulp and other by-products are made available to the farmer at reasonable figures; and on the other hand, the farmer cannot get the full benefit out of sugar beet growing by economizing land for fodder purposes unless he is fully supplied with these by-products. The association of a factory drawing beets from a narrow radius with a utilization of by-products within the same radius is of fundamental importance to the manufacture of sugar and the successful pursuit of farming. Finally, it should be more widely realized that the supply of a large tonnage of beet per acre usually carries with it a large supply of tops and leaves, and a correspondingly high tonnage of pulp to be claimed.

TABLE XXIV. *Costs of Production.**A. Germany.*

	<i>Garcke.</i>		<i>Verein der Deutschen Zucker-Industrie.</i>		<i>Landwirtschafts-Kammer, Halle.</i>	
	<i>Year 1925.</i>		<i>Year 1924-5.</i>		<i>Year 1925-6.</i>	
	<i>Per acre.</i>	<i>Per cent.</i>	<i>Per acre.</i>	<i>Per cent.</i>	<i>Per acre.</i>	<i>Per cent.</i>
	£ s.		£ s.		£ s.	
Labour:						
Cultivations to drilling . . .	4 10	20.1	2 14	11.6	2 15	15.3
Summer operations . . .	2 3	9.6	1 8	6.0	1 5	6.9
Harvesting . . .	1 9	6.5	1 5	5.4	1 13	9.1
Haulage . . .	1 10	6.7	0 17	3.7	1 9	8.0
Total labour . . .	9 12	42.9	6 4	26.7	7 2	39.3
Manures:						
Dung . . .	4 15	21.3	3 7	14.4	2 15	15.3
Artificial . . .	2 17	12.8	2 12	11.2	2 8	13.3
Seed . . .	—	—	0 10	2.2	0 8	2.2
Value of land, &c. . .	2 8	10.7	5 14 ²	24.6	2 8	13.3
Other expenses . . .	2 15	12.3	4 17	20.9	3 0	16.6
Total gross cost . . .	22 7	100.0	23 4	100.0	18 1	100.0
Credits:						
Manurial, &c., residues . . .	1 18	—	1 6	—	—	— ³
By-products. Tops and leaves ¹	3 7	—	0 15	—	—	— ³
Pulp . . .	2 8	—	2 6	—	—	— ^{3,4}
Total credits . . .	7 13	—	4 7	—	—	—
Net cost . . .	14 14	—	18 17	—	—	—
Yield, tons . . .	9.56		13.50		12.00 ⁵	
Net cost per ton . . .	30s. 9d.		27s. 11d.		30s. 1d.	
Net cost per ton (in marks)	31.4		28.5		30.6	

¹ Cost of collecting, carting, and storing tops and leaves has been deducted in each year.² Reckoned by taking 9 per cent. interest on ground value (*Grundwert*) of 800 marks.³ Credits not given.⁴ Value of pulp, mostly given free in this district.⁵ Estimated yield for district.*B. Holland. Year 1926.*

	<i>Friesland.</i> <i>Average of several growers.</i>		<i>Zeeland.</i> <i>Average of several growers.</i>
	<i>Per acre.</i>	<i>Per cent.</i>	<i>Per acre.</i>
	£ s.		£ s.
Labour:			
Cultivations to drilling . . .	2 0	9.7	3 3
Summer operations . . .	—	—	1 18
Harvesting . . .	6 0	29.0	2 10
Haulage . . .	—	—	2 8
Total labour . . .	8 0	38.7	9 19
Manures:			
Dung . . .	1 7 ¹	6.5	1 0 ¹
Artificial . . .	2 7	11.4	3 11
Seed . . .	0 8	1.9	0 8
Value of land . . .	5 9	26.3	5 7
Other expenses . . .	3 3	15.2	1 12
Total gross cost . . .	20 14	100.0	21 17
Credits:			
Manurial residues . . .	—	—	—
By-products. Tops and leaves .	4 0	—	3 0
Pulp . . .	—	—	—
Total credits . . .	4 0	—	3 0
Net cost . . .	16 14	—	18 17
Yield, tons . . .	11.95		14.00
Net cost per ton . . .	28s. 0d.		26s. 11d.
Net cost per ton (in gelders) .	16.95		16.25

¹ Once in 7 years.*C. Belgium. Year 1925.*

<i>Flanders,</i>	<i>Flanders,</i>	<i>Alluvial</i>				
------------------	------------------	-----------------	--	--	--	--

VIII. COSTS AND RETURNS

IN attempting to ascertain the costs of production of beet in the countries visited, two main difficulties were encountered: first the fact that there is no marked tendency among farmers to keep records of this nature, and secondly that where costs are kept, there is no uniform system on which they are based.

It was possible, however, to collect statements of cost from four different sources in Germany, from two in Holland, and from one in Belgium. These figures are based on estimates of average conditions. The German costs were provided by the Landwirtschaftskammer (Farmers' Union) of Saxony, the Verein der Deutschen Zucker-Industrie, Berlin, and the Agricultural Department of Halle University. A fourth German cost was taken from a publication by Garecke. The Dutch costs were supplied by the Handelsconsulent (Agricultural Organizer) of Friesland and the Secretary of a factory, who is also the manager of a large estate. The Belgian figures were obtained from a report of M. Jules Dubois for the Sugar Beet Growers' Association.

The costs so obtained have been converted into English currency at appropriate rates of exchange,¹ a course of action which is inevitable, but which necessitates the exercise of caution when attempting to interpret results. The figures are shown in Table XXIV (*A*, *B*, and *C*).

In France it was not found possible to obtain statements of costs, owing to the reluctance of farmers and others to commit themselves, in view of the unstable condition of the exchange.

Labour

The proportion of the cost of growing the crop which is taken by labour, including the use of horses, varies from 26.7 per cent. to 45.6 per cent., being approximately 40 per cent. of the total cost. Although this proportion is slightly less than is found in this country, it illustrates the importance which attaches to this part of the cost. The actual costs, when compared in terms of British currency with corresponding figures in this country, are generally speaking

¹ Germany and Holland, par of exchange. Belgium, 100 Belgian francs to the pound sterling. For the year represented by these costs the franc fluctuated between 91.45 and 112.50.

rather low, ranging from £6 4s. 0d. to £10 12s. 0d. per acre, as against an average of about £11 in England. Although the cost is low, however, it probably represents actually more time worked on the crop, as may be readily inferred from a study of the following examples of actual rates of wages.

Rates of Wages. Time-work

GERMANY. (*Farm in Saxony.*)

Regular horsemen in 1926 for a 60-hour week received 20 marks a week, plus 15 per cent. extra from 5 July to 5 October, together with a house, firewood, 1,000 lb. of corn, an acre of land, or its equivalent in potatoes.

In English money this might represent 26s. 2d. a week, or 5½d. an hour.

Casual labourers received (a) women, 16 pf. per hour, together with 2½ lb. of wheat or rye and 10 lb. of potatoes a week from 1 July to the end of the sugar-beet harvest; (b) girls, 12 pf. per hour, with half the above allowances. In each case lodging is provided. These wages apply for a 60-hour week. Overtime beyond the 10 hours a day is paid 45 per cent. higher.

The English equivalent would be about 13s. a week, or 2·6d. an hour for women, and 9s. a week, or 1·8d. an hour for girls.

On other farms visited similar rates of wages were paid.

HOLLAND. (*Farm in Zeeland.*)

Horseman, from 750 to 800 f. (gelders) per year, together with ¼ acre potato land on which all horse-work is done gratis, and rebate on cottage rent equivalent to 1 f. a week.

In English money this would be about 27s. 8d. a week.

Regular day-labourers, December to April inclusive, 2 f.; May and June, 2 f. 25; July to November inclusive, 2 f. 50 a day. During threshing, hay-time, &c., 0 f. 25 to 0 f. 50 a day extra. In May the hours worked were 10 hours a day from Monday to Friday, and 8 hours on Saturday (58 hours a week).

In English currency this represents about 22s. 6d. a week, or 4·6d. an hour.

The official statistics give the following particulars for Zeeland (St. Philipsland):

Foreman, March to July inclusive, 16 f. 75; August to November inclusive, 19 f. 50; December to February inclusive, 13 f. 50 per week, together with a house, ½ acre of potato land, and 15 f. bonus a year.

The English equivalent would amount to £78 3s. 4d. a year.

Other regular workers for the same periods as above are paid 15 f. 75, 18 f. 50, and 12 f. 50 respectively, with allowances as for a foreman.

The English equivalent would be about £73 18s. 4d. a year.

Farm in Friesland.

For time-work from daylight to dark (approximately 63 hours a week in summer) the rate is 0 f. 30 per hour. The English equivalent would be 6d. an hour.

These figures are confirmed by the Dutch Agricultural Statistics, which also state that piece-work rates are rather higher.

Farm in Brabant (sandy district).

Day-wages were from 2 f. 50 to 3 f. for an 11-hour day, equivalent to 4½d. to 5½d. an hour.

BELGIUM.¹ (*General.*)

Horseman, 22 fr. per 10-hour day, together with the free use of animals and implements for working his own land, about 5 tons of beet tops and leaves, 5 tons of wet pulp at half-price, 100 fr. for harvest, 5 fr. a day extra for cutting and stacking corn, and a wage up to 40 fr. a day during beet-lifting.

The English equivalent would be about £45 per annum (converted at 175 fr. to the £).

Slightly higher wages for the same hours were paid in some districts.

Tournai. Regular hands.

Horseman, 3,600 to 4,800 fr. a year in cash. This represents a wage of about £20 10s. 0d. to £27 10s. 0d. a year.

Labourer, 2,400 to 3,600 fr., or £13 14s. 0d. to £20 10s. 0d. a year.

Woman, 2,400 fr., or £13 14s. 0d. a year.

Boy, 1,200 fr., or £6. 17s. 0d. a year.

In each case food and lodging is provided in addition.

Casuals.

Man, 15 to 20 fr. a day, or 1s. 8d. to 2s. 3½d.

Woman, 10 to 15 fr. a day, or 1s. 2d. to 1s. 8d.

Boy, 10 fr. a day, or 1s. 2d.

In each case with food.

So far as the summer and autumn work is concerned, a great deal is done at piece-work rates, either by the regular farm hands or by casuals. The following examples give some indication of these rates:

Rates of wages. Piece-work.

GERMANY. (*Verein der Deutschen Zucker-Industrie, Berlin.*)

	Per acre.	
	s. d.	R. marks.
Summer work, first hand-hoeing . . .	7 4	7.30
bunching and singling . . .	11 0	11.00
seconding . . .	9 2	9.16

¹ At the time these figures were obtained (October 1926) a new Belga currency was established. The par value of the Belga is 35 to the £, one gold Belga being equivalent to 5 paper francs.

COSTS AND RETURNS

81

	<i>Per acre.</i>	
	<i>s. d.</i>	<i>R. marks.</i>
Harvesting (pulling, topping, and heaping, the equivalent of 13½ tons of washed beet) . . .	26 0	26·00
HOLLAND. (<i>Farm in Zeeland.</i>)		
		<i>Gelders.</i>
Summer work, bunching, singling, and subsequent cleaning (usually two hand-hoeings) . . .	33 8	20·2
This rate is fixed by agreement between farmers' and labourers' unions.		
Harvesting, beginning of season	50 6	30·3
end of season	55 4	33·2
(Pulling, topping, heaping, and loading the equivalent of 14 tons of washed beet.)		
<i>(Farm in Friesland.)</i>		
Summer work, bunching only	12 8	7·6 ¹
Harvesting, lifting, cleaning, topping, and loading the equivalent of about 11·95 tons of washed beet	67 6	40·5
BELGIUM. (<i>Farm in Namur.</i>)		
		<i>Francs.</i>
Singling, seconding, pulling, topping, and loading the equivalent of about 11·16 tons of washed beet	18 6 ¹	162·0 ¹
<i>(Farm in Liege.)</i>		
Summer work, bunching and singling	13 10 ¹	121·5 ¹
Harvesting, pulling, topping, and loading the equivalent of about 11·95 tons of washed beet	20 9 ¹	181·4 ¹
<i>(Farm in Namur.)</i>		
Summer work, bunching, singling, seconding, at 15·7 in. between plants	17 4 ²	152·0 ²
„ 15·1 „ „ „	17 9 ²	156·0 ²
„ 14·5 „ „ „	18 3 ²	160·0 ²
„ 14·0 „ „ „	18 8 ²	164·0 ²
Harvesting, pulling, topping, and loading the equivalent of about 11·16 tons of washed beet	24 2	212·2
<i>(Farm in Hainaut.)</i>		
Harvesting, pulling, topping, and loading the equivalent of 11·95 tons of washed beet	30 0	263·1
<i>(Tournai district.)</i>		
Hoeing, singling, pulling, and topping	46 3 to	405·0 to
	55 6	486·0
Sometimes up to	64 9	567·0

¹ Plus food and, in some cases, lodgings.

² Plus lodging, food, fuel, and light to the value of 30·4 francs or 3s. 6d.

an acre.

Other cases met with are similar, and vary within the limits shown above.

It would seem, therefore, that a regular horseman in Germany and Holland receives wages in the neighbourhood of 27s. a week, and in Belgium even less, while day-labourers and casuals on time-rates may receive anything from about 22s. 6d. to 30s. To this must be added the fact that foreign gang labour is often reckoned to be worth approximately 2½d. an hour (1½d. wages, 1d. allowances).

Rates of wages of this order would indicate a plentiful supply of labour, and this fact, coupled with its cheapness, must react favourably upon the growing of a crop such as sugar beet which makes heavy demands on labour. Moreover, the low costs of labour per acre show that the work is efficient, while the high yields result in low costs per ton.

One of the main features to be observed in this connexion is the considerable use that is made of the gangs of migratory labourers already referred to, who undertake the summer work and harvesting at piece-work rates of wages. It is important to bear in mind, however, that in all countries the crop is grown to a large extent by small-holders and peasant-proprietors under conditions which do not give rise to the payment of direct wages. This crop, with its heavy labour demands, is particularly suited to this class of cultivation.

Manures

The second item of cost in order of importance is that of manures. The proportion of the gross cost expended under this head varies from 25.6 to 38.9 per cent. in Germany, from 17.9 to 20.8 per cent. in Holland, and from 33.4 to 46.1 per cent. in Belgium. The lower figure shown by Holland is due to the fact that the charge for farmyard manure is spread over seven years in the costs given for that country. The question of manuring has been already discussed, but attention may here be drawn to the fact that the higher scale of manuring adopted on the Continent involves a higher cost than is commonly incurred in this country. When the residual value of the manures and the value of the by-products are taken into account, however, the cost of the manures per ton of beet is on the whole no greater than is usually found in England.

Value of Land, &c.

The systems of land tenure prevailing on the Continent make it difficult to state figures comparable to what is understood by the word *rent* in this country, and the figures shown under the heading 'value of land, &c.' are those given by the various authorities from whom costs were obtained, as representing the approximate value of typical beet-growing land in the countries concerned. In some cases they also include rates, taxes, upkeep of dykes, &c., which in many cases are paid by the landlord. The very high figure shown in the second German cost (Table XXIV), which was given as being typical for the whole country, was calculated by the authority concerned by taking 9 per cent. interest on the ground value.

The rents and capital value of land are always relatively higher on small holdings than they are on larger farms, and in all the countries visited the average size of holding is smaller than in this country. Moreover, there is a great demand for land on the Continent, especially perhaps in Holland and Belgium, a factor which tends to make land expensive, whilst the soils devoted to sugar beet are always fertile, and are not usually difficult to work, though the French sugar beet soils are on the whole rather stiffer than those in the other countries visited.

For these reasons the value of land shown in the tables, and especially for Holland, is high.

Other Expenses

These include the ordinary overhead charges. In most cases a management charge and a charge for interest on money laid out has been added, together with any taxes not included under 'value of land, &c.'. The charge for interest may amount to a considerable figure, as, for example, in costs Nos. 1 and 3 for Germany, where it was given separately, and where it amounted to 17*s.* and 14*s.* per acre respectively. In the two Dutch costs this figure was 7*s.* 4*d.* and 6*s.* 8*d.* an acre, and in the Belgian costs 12*s.* an acre in every case.

General Remarks

The salient features are that land values and costs of manures are high, while labour costs are low. These facts result in a series of total gross costs not unlike those found in this country. High values are placed on residual values and by-products, however, and these, when credited to the crop,

reduce the costs considerably. The yields obtained are also high, and when the net costs per acre are related to them, low net costs per ton result. These costs per ton range from 20s. 7*d.* to 30s. 9*d.* in Germany, are 26s. 11*d.* and 28s. in Holland, and average 32s. in Belgium.

Returns

The difficulty of ascertaining the prices paid to the growers for the beet is enhanced by the fact that there is no general price agreed on a national basis, each district or factory paying a price which is often variable for each individual grower, and which also may be high or low according to the efficiency of the factory concerned. Prices which may be taken as representative of recent years are given in Table XXV, together with their sterling equivalents.

Owing to the instability of the franc at the time of this inquiry, sterling values in respect of French prices have not been calculated, while those for Belgium are for the years subsequent to stabilization of the franc. It will be noticed that there is no consistency between countries in the general trend of prices. German prices have improved from the low level of 1925-26, and French prices also show a rise after 1924-25. This, however, may be due more to the fall in the value of the franc than to any improvement in the market for the commodity. Dutch prices over the similar period show a steady decline. No official statistics are yet available in respect of the prices paid in Holland for the 1927-8 crop. However, one grower in Friesland expected to be paid 35s. 3*d.* per ton of washed beets on a 'participating' contract; and it was stated that on a 'non-participating' contract the price was 30s. 3*d.* per ton for 17 per cent. sugar. These prices show a considerable rise when compared with the average figures of the previous year. Belgian figures show an improvement since 1925, due very largely, however, to the fall in the value of the franc.

Any one attempting to compare Continental prices with those prevailing in this country will be confronted with grave difficulties, some due to monetary instability, some to fiscal conditions, and others on account of the differences in the contractual relationships between factories and growers. With regard to the latter, there are considerations, other than the actual cash basis of the contract, which would have the effect of making the Continental price per ton appear lower, if

TABLE XXV. *Average Prices paid for Sugar Beet.*

	Year.	Price per 1,000 kg. washed beet.	Sugar content. ¹ Per cent.	Equivalent price per ton of washed beet in sterling.
		<i>R. marks.</i>		<i>s. d.</i>
<i>Germany.</i> ²	1925-6	c. 22·30	15·89	22 8
	1926-7	c. 32·00	15·59	32 6
	1927-8	c. 32·00	15·45	32 6
		<i>Gelders.</i>		
<i>Holland.</i> ³	1923-4	21·80	15·75	37 0
	1924-5	20·00	17·00	33 11
	1925-6	19·25	17·22	32 8
	1926-7	15·25	—	25 11
		<i>Francs.</i>		
<i>France.</i> ⁴	1922-3	108·13	12·26	—
	1923-4	177·75	11·57	—
	1924-5	145·24	12·23	—
	1925-6	158·82	12·65	—
	1926-7	223·09	12·97	—
<i>Belgium.</i> ⁵		<i>Francs.</i>		
Tirlemont.	1921-2	96·00	} These prices are for 16 per cent. of sugar.	—
	1922-3	96·00		—
	1923-4	192·00		—
	1924-5	168·00		—
	1925-6	109·12		—
	1926-7	223·33 ⁶		26 0
Wavre.	1927-8	202·24 ⁶		23 6
	1921-2	108·72 ⁷		—
	1922-3	95·54		—
	1923-4	194·55		—
	1924-5	166·34		—
	1925-6	116·21		—
	1926-7	155·86		18 1
	1927-8	210·10		24 5

¹ These figures represent for Germany, raw sugar; for Holland, total sugar; for France, refined sugar.

² From the Verein der Deutschen Zucker-Industrie, Berlin.

³ Official statistics representing prices paid by the Central Sugar Company.

⁴ Supplied by the Comité Central des Fabricants de Sucre de France.

⁵ No figures obtainable for Belgium as a whole. The figures given are supplied by the Ministère de l'Agriculture, and relate to four important factories.

⁶ Plus 60 per cent. free pulp.

⁷ Plus 600 kg. free pulp every year.

TABLE XXV.—*continued.*

	Year.	Price per. 1,000 kg. washed beet.	Sugar. content. Per cent.	Equivalent price per ton of washed beet in sterling.	
<i>Belgium (continued.)</i>				s.	d.
Selzaete.					
(a) West Flanders	1921-2	90.00	These prices are for 16 per cent. of sugar	—	—
	1922-3	80.00		—	—
	1923-4	160.00		—	—
	1924-5	165.00		—	—
	1925-6	145.00		—	—
	1926-7	225.00		26	2
	1927-8	270.00		31	5
(b) Dutch frontier zone.	1921-2	100.00		—	—
	1922-3	75.00		—	—
	1923-4	130.00		—	—
	1924-5	165.00		—	—
	1925-6	150.00		—	—
	1926-7	210.00		24	5
	1927-8	265.00		30	10
Anvaing.	1921	100.00		—	—
	1922	90.00		—	—
	1923	160.00		—	—
	1925	135.00		—	—
	1926	250.00 ¹		29	1
	1927	250.00 ¹		29	1

compared with English prices under equal conditions. The Continental farmer in most cases does not pay rail carriage on beets, while in Germany and Belgium he usually also receives a free allowance of pulp, both wet and dry, which in some cases is carriage paid to his local station.

On the other hand, it has been the policy in France, Belgium, and Germany to levy duty on foreign imported sugars. To what degree these duties have acted as a measure of protection to the home sugar industry in these countries, and consequently to what extent they have influenced the prices paid for sugar beet, it is impossible to say. They cannot, however, be disregarded in price comparison with those prevailing in this country.

¹ Plus 50 per cent. free pulp.

Continental sugar beet prices are in fact influenced by the play of a number of factors which are not alike for each individual country, and some of which are comparatively unstable. With so many differentials it is not advisable to construct figures which might be comparable with those prevailing in this country. Dutch figures, with corrections for rail carriage, would perhaps more normally represent those pertaining to a free market price.

The average prices quoted for Germany, Holland, and Belgium may be most usefully compared with the average costs of production shown in Table XXIV (*A*, *B*, and *C*). In Germany it is generally acknowledged that post-war prices for sugar beet have been unremunerative to the growers. Only in 1926-7, for the first time since the War, was the price considered to be a reasonable one. Similar views of the unsatisfactory nature of sugar beet prices were held by growers both in France and Belgium.

IX. TRANSPORT

THE problem of conveying the beets to the factory is on the whole less difficult on the Continent than in this country. The two main factors contributing to this result are, first, the greater concentration of factories, or of factory receiving points, in sugar-growing districts of the Continent, and secondly, the rather wider choice of alternative methods of transport generally available. Both of these factors tend to lessen the cost of transport, the first by reducing the distances over which the roots must travel, and the second by making freight-rates more competitive.

Distance from Farm to Factory Receiving Points

The greater concentration of factories is primarily due to the fact that the higher the proportion of land devoted to beet and the higher the average yield, the smaller is the area required to supply a factory of given size. In both these respects the main sugar-producing areas of Europe are at present superior to this country. It is not uncommon to find, for example, that a factory with a capacity of 800 tons of beet a day, and working, maybe. 70,000 tons during a campaign, will draw 60 per cent. of its beets from within a radius of 10 miles, while no grower will be more than about 25 miles distant. A further cause is to be found in the relative size of the factories. In this country, where it has been possible to start the industry on modern lines, the tendency has been to build large factories in order to minimize overhead charges, and to operate with the utmost factory economy. On the Continent, on the other hand, where the industry began at the beginning, and developed gradually, the factories have been smaller. This is no doubt to be explained, among other things, by the fact that as the yields of sugar per acre improved, and the factories found it possible to obtain their required raw material from reduced areas, opportunities would arise from time to time for erecting new factories, albeit not large ones, between the spheres of influence of the existing factories. In France many sugar factories were destroyed during the War, and the tendency now is undoubtedly to replace several small pre-war factories by one large new one. One factory at least in the north of France is

now doing the work of twelve pre-war factories. In other countries, whenever rebuilding takes place, the same tendency is noticeable. This, however, does not always mean any great increase in the distances over which the beets have to be transported, because although the principle in these areas now is to have a large central factory where the complete process of sugar manufacture is conducted, as in most of the factories in this country, nevertheless each of these central factories is often in touch with several subsidiary plants, known in France as *râperies*, where the juice is extracted, but not treated, and is then sent by means of underground pipes to the central factory. The distance over which the whole beets have to travel, therefore, is not the distance to the nearest factory, but to the nearest *râperie*. Moreover, in places where there is a sufficient concentration of beet-growers to justify the outlay, the factories establish collecting points (known sometimes as *bascules*), where the farmers may deliver their beets, and where they are taken over by the factory after being weighed and sampled as if they had been delivered to a factory or *râperie* in the usual way. So far as the farmers are concerned, therefore, this factor means a reduction of distance.

Alternative Methods of Transport

So much for the influences operating towards reducing distances. As regards the choice of alternative methods of transport, there is, first, the system of *vicinal* or narrow-gauge railways which obtains extensively in France and Belgium and to a lesser degree in Holland, and, secondly, the greater use that is made of water transport in all the countries visited, but especially in Holland. Motor transport is used to some extent, but, probably owing to the other alternative methods available, it has not been developed very fully.

Vicinal Railways

The narrow-gauge railways are laid out essentially to provide communication, for both passengers and goods, between neighbouring villages or large farms in country districts, and, since they are not concerned with fast through-traffic, neither their permanent way nor their rolling stock has need to conform to the expensive standards of construction and upkeep usually associated with railway engineering. Judged by any standards other than that of utility, the system must be

condemned. The permanent way is laid at random, frequently along main roads, sometimes across country, and, at intervals, through the narrowest village streets. As with tramways in this country, there is no attempt at fencing, whilst level-crossing gates are unknown. As a means of transporting agricultural produce, however, the system has considerable merit. The network of lines is very complete, and the distances between loading points are short, making comparison with the broad-gauge railways favourable, whilst the wagons, being long and low, are capable of heavy loads (up to about 10 tons), giving a distinct advantage over road vehicles. These vicinal railways are connected up at intervals with the main railways in such a way that the narrow and broad-gauge wagons can be run alongside each other, making transshipment as easy as possible, whilst in many cases the narrow-gauge track runs direct into the factory yards, so that re-loading is often unnecessary.

Water Transport

Waterways are used to their fullest extent, not only in Holland, but also in Belgium, France, and Germany. In Holland especially the use of water transport is encouraged because of its comparative cheapness, which, besides other advantages, enables beets to be drawn economically from a larger area than would be possible were more expensive methods of conveyance alone available. In Zeeland this is important, because, owing to the scarcity of fresh water on the islands, all the factories must be on the mainland. These factories, however, do not care to rely wholly on the ship-borne beets from Zeeland, as fog and bad weather may temporarily prevent delivery by this means, but owing to the significant proportion of their supply which is brought by water, the shipping price forms the foundation price for beet conveyance, and the proportion of beet delivered by rail is therefore carried at rates cut down towards the water freightages.

In other parts of Holland, and in the other countries visited, the proportion of beet carried by water varies according to circumstances, but it is true to say that far greater use is made abroad of inland waterways than is the case in this country. Factories which receive anything up to 40 per cent. of their supplies by water are common, and the rates charged are often less than half the corresponding rates by rail.

Comparative Unimportance of Transport Costs

The foregoing argument shows how the question of transport costs is of less importance to the industry abroad than it is at home, and it helps to account for the fact that, whereas these costs in England comprise some 10 or 12 per cent. of the total cost of growing and delivering of the crop, on the Continent they probably represent on the average not more than about 5 per cent. Moreover, whereas in this country the cases in which beet is grown so close to a factory that transport charges in the sense here understood are not incurred at all are few, such cases on the Continent are many.

But wherever these costs exist, however large or however insignificant they may be, they always form a charge which must be met out of the proceeds of the industry in whatever country it is carried on, and it is interesting therefore to study the various methods by which this charge is apportioned between the parties responsible for its payment.

Method of Payment

Wherever receiving points, or *bascules*, are in use, the transport charges between such points and the factories are always reckoned to be a factory cost. Apart from this the costs are borne either directly or indirectly by the growers. In France it seems to be the usual practice for the factories actually to pay the freightage, but a sufficient sum is deducted from the contract price paid for the beet to cover the average cost of transport. In this way there is no special advantage for the farmer who is close to the receiving point, unless he is so close as to be able to cart his beets direct in his own wagons, in which case he may be able to benefit by the use of whatever labour-saving devices may be provided there for unloading beet or for loading pulp. And in point of fact, owing to the short distances involved, the majority of growers would probably fall in the latter category. Most factories also pay a small premium for beet delivered direct to the factory by the farmer's own equipment.

In Belgium the common practice seems to be based on the same plan as in this country, though differing from it in detail. The price to be paid for the beet is determined excluding the cost of transport but including the price of the pulp, it being assumed that all growers will buy back their full quota, and from the net sum thus due to each grower his freightage cost is deducted on his account. The

reason for including the several transactions in one account is due to the system of taxation to which reference has already been made. Cases were met with in Belgium where the factory does not directly charge the grower with the freightage cost, but in this event a considerably higher premium is paid for beets delivered by the farm equipment. This method therefore approximates to the French plan already described. In some cases the beets delivered direct by the farmers are unloaded by the farm hands, in others by factory hands, the practice varying from factory to factory.

In Holland and Germany a great many of the factories are owned co-operatively by the growers, and the factories usually pay for the transport. This means that the charge falls on the growers by virtue of their being shareholders in the factories rather than in their capacity of farmers. In the case of some of the earliest established factories, however, the farmers pay the freight individually. This is due to the fact that competition was less active at that time, and the factories could easily maintain their supplies by taking beets from those growers only who were in a position to transport it profitably at their own charges. With the increase in the number of factories, and the consequent competition for supply of roots, it has become more customary for the factories to pay the freight, which is thus shared out among the growers, enabling the factory to draw beets from a wider radius. With this method, as with the French method already described, it is necessary to provide safeguards for those growers who are closer to the factories. In most cases there is a limit of distance beyond which each grower must pay the extra cost, and this distance varies according to the concentration of beet-growing around each factory. The limit is about 12 miles in ordinary cases, up to about 50 miles in the case of the mainland factories drawing their supplies from Zeeland by barge. The majority of growers for each factory, however, are situated within the stated distance. In order that farmers who use reasonable care in cleaning their beets may not be penalized, various plans are adopted, of which perhaps the most common is to assess the deduction for any tare above, say, 20 per cent. at double rates.

Apart from the small premium which is usually payable to growers who deliver direct, these growers are compensated by the considerable advantages which they enjoy in the way of being able to deliver their roots and collect their pulp

more or less at times to suit themselves, and their wagons seldom need to make a journey unloaded. Farmers who deliver to the rail or wharf, on the other hand, may have to wait for wagons or barges, and may have to return to the farm empty, and make a second journey in order to fetch the pulp. The growers who are close to the factory are also in a better position to benefit from the supply of waste lime.

X. RECEPTION OF BEETS AT FACTORIES

Sampling

THE first operation after the arrival of the beets at the point where they are to be taken over by the factory is the calculation of the value of the consignment. This depends on the weight of roots delivered in sound condition, and usually on the proportion of sugar contained in them. As in this country, the calculation is made by sample. The size of the sample in relation to the bulk varies considerably, but in all cases it bears a very small ratio to the whole consignment. It is usually taken in a basket which contains approximately $\frac{1}{2}$ cwt. of roots, and one sample is taken from each vehicle, whether road or rail, though in the case of large consignments, as, for example, in barges, it is sometimes stipulated that there shall be a larger number of samples taken, say, one sample for every 5 tons. It cannot be maintained that a sample of this size, which is about half of 1 per cent., accurately represents the bulk from which it is taken, but there are practical difficulties to a larger sample, and it is probable that no advantage accrues either to buyer or seller in the long run as a result of any discrepancies there may be. The grower of a small acreage runs a greater risk in this respect than does the larger farmer, and it is possible that in any one season sufficient samples might not be taken from a crop off a small acreage to allow the errors to compensate.

Determination of Weight

In order to measure the tare, by which is meant in this case the difference between the gross weight delivered and the net weight of usable beet, the entire sample is first weighed in the basket in which it has been collected. The beets are then taken out and cleaned. This may be done by passing them through a washing machine—a replica in miniature of the main washing plant in the factory—or, more often, a gang of women or boys will sit round the weighing room and scrape the dirt from roots with the back of a knife, at the same time cutting off the rootlets and any parts diseased or damaged by frost or in other ways, as well as any of the crown which has been left above the lowest leaf-scar. Everything thus removed from the beet is returned

to the basket, which is weighed again, the difference between the two weighings representing the net weight of beet accepted by the factory. The farmer, or his representative, may be present at this operation, but at the factories which are owned co-operatively by the farmers, it is found that this privilege is not often exercised, as the growers who may be unwilling to accept figures from an independent company will not question the returns of their own factory.

The removal of the rootlets occasions some comment, since they undoubtedly contain their share of sugar. At some factories the rootlets which are knocked off in the process of washing, together with the miscellaneous mass of vegetable matter which collects against the gratings of the washing machines, are mixed in with the wet pulp, the value of which is increased to some extent by this means. Other factories discard all this material as waste. But at one factory visited the residues from the washings are actually picked over by hand, so that the juice from the rootlets can be extracted, and used along with that from the main bulk of the roots. In this way, it was claimed, the proportion of sugar delivered by the farmers which is lost by the factory is very much less than in a neighbouring factory where no attempt is made to save the sugar in the rootlets. It is clear, however, that if these rootlets are cut off from the sample and weighed as tare, any sugar which may be extracted from the corresponding rootlets in the bulk is a free gift from the farmer to the factory. There results therefore in some cases a clause in the contract by which the factory undertakes to use washing machines so constructed that roots of more than $\frac{2}{5}$ of an inch in diameter shall not be lost, and only rootlets smaller than this are counted as tare.

Determination of Sugar Content

In those cases where variation of sugar content affects the price to be paid for each consignment of roots, and this is nearly always the method employed,¹ the sample is next tested for sugar content. For this purpose specimen roots are selected. In Holland it was found that six roots were selected from each sample, two large, two medium sized, and two small roots. Each of these is pressed against a revolving

¹ In France it was found that in some cases each load is paid for by weight only. The price is fixed each year for all growers on an assumed sugar content (in 1926 this was $16\frac{1}{2}$ per cent.).

grater which cuts out a sector in the form of sawdust. This 'sawdust' is analysed for sugar content. In Belgium it is more customary to take 3 roots only, each of which is cut in half from top to bottom, half of each root being pulped. In Germany a larger number of roots is often used, and a sample taken from each by a borer which is driven diagonally through the root, starting from the edge of the knife-cut and passing through the centre of the root, and out at the other side near the tail. In all cases the quantity of material actually analysed for sugar content thus represents a still smaller fraction of each consignment than does the sample from which the tare is determined. The actual method of analysis varies. Sometimes the juice is subjected to the polariscope, but frequently the density of the juice only is ascertained, since there is a direct ratio between sugar content and density, and the latter is the more easily determined.

In France an unusual method of ascertaining the value of the beet crop is sometimes found, which, at the option of the farmer, is alternative to the ordinary method. A representative of the factory visits each grower just before harvest and measures the weight of beet from a sample plot of about 3 yds. square in each field. The factory then accepts and pays for the whole crop on the basis of the sample. This is a popular method among the farmers, and is adopted by the majority of those who grow beet for the factories where the choice is available. There are certain precautions which have to be taken to safeguard the various interests involved, especially those of the factory, since the grower having sold his crop by sample may be tempted to cut off more crown than is strictly necessary, in order to increase his yield of cattle fodder, or even to leave some roots in the ground in order to reduce his harvesting costs. In most cases the growers are closely concentrated round the factories, whose inspectors are thus able to keep their eye upon the operations without great difficulty.

The system of receiving beets at collecting points at a distance from the factory involves some modification of the usual practices, since it is impracticable to keep chemical analysts at each of these points. The measurement for tare by sample is carried out at the loading point in the same way as at the factory, but for the determination of sugar content the sample is put up in a sealed bag and sent to the factory either by post or in the same conveyance as the bulk of the

roots. There is a clause in some contracts under which the factory refuses to accept beet of a sugar content less than 14 per cent. This is usually found where beets have to be transported over considerable distances, making it important to economize freight charges so far as possible, as, for example, in the case of the island-grown beets of Zeeland. If such a consignment is delivered to a loading point, it is often impossible to refuse it, since the sugar analysis of the sample may not be made until after the bulk has been mixed with other farmers' roots either in a barge or in the flumes at the factory. In these cases the controller at the loading point is notified that he is not to accept the next consignment delivered by the same farmer until after the result of the analysis has been returned by the factory.

Unloading at the Factory

On arrival at the factory the roots are unloaded into flumes. In many cases these are below the level of the ground, so that as much use as possible may be made of the force of gravity. At one large factory in France, for example, an electrical device has been installed by which the railway wagons may be tipped sideways, allowing the roots to fall into the underground flumes, an operation which takes about five minutes, as against forty minutes which was the time taken when the beets had to be pitched out by hand. Road wagons are unyoked and tipped backwards on an electrically controlled platform. When machinery of this kind is not available, the use of a water-jet for washing the beets out of wagons is not uncommon, and in any case there is a great saving of time and labour, even when the beets have to be unloaded by hand, if, instead of being pitched upwards, they can be unloaded by a raking action and allowed to fall into the flumes below.

In many cases, however, owing to the water-level or to the configuration of the ground, the flumes must be at ground-level, and it is usual in these cases to make use of derricks and cranes with some form of *grab* with which to unload railway wagons and barges, though the roots in road wagons, in the absence of a special ramp, have mostly to be pitched by hand.

The heavy work involved in hand-pitching is done in some cases by the farm hands, in others by labourers provided by the factory, and in the latter event some factories employ foreign labour engaged for the purpose.

XI. PRICE-FIXING

IN Holland, where it is believed that 70 per cent. of the beets in the country are grown for factories owned by the farmers on a co-operative basis, and in Germany, where a similar or even greater percentage of growers are shareholders in the factories, the question of price-fixing assumes less importance than it does in countries where the farms and the factories are owned independently.

This follows from the assumption that if the farmers who are financially interested in a factory receive too small a price for their beet, the factory will make a corresponding profit, but the farmers will be recouped when they receive their share of that profit. Although the farmers as a whole thus receive full payment, it does not necessarily follow that the apportionment will be exact as between individual farmers. In order to make it so, it is necessary when distributing the final payment to take account not only of the quantity but also of the quality of the roots delivered by each farmer. This is a comparatively simple matter, as an example based on the practice of one of the large Dutch factories will show. Supposing the factory, which has already advanced perhaps 80 per cent. of the value of the roots to the growers, to have concluded the campaign with a surplus of receipts over expenses of $\text{£}x$, this is the additional sum which falls to be paid over to the growers. Supposing further that the factory received a total of 100,000 tons of beet with an average sugar content of 16.5 per cent., this represents 16,500 tons of unworked sugar, in final payment for which $\text{£}x$ is now available. In other words, $x \div 16,500$ is the price the factory must now pay per ton of unworked sugar. The quantity of unworked sugar delivered by each farmer is calculated in the same way. Thus farmer A may have delivered 50 tons of beets with 17 per cent. sugar (8.5 tons of unworked sugar), farmer B 70 tons with 16 per cent. sugar (11.2 tons of unworked sugar), and so on. Farmer A will therefore receive in final payment $\text{£}8.5 (x \div 16,500)$, and farmer B $\text{£}11.2 (x \div 16,500)$.

Other factories adopt different methods for arriving at a similar result, but in every case, so far as is known, the final distribution is made on the basis of quality as well as of quantity of beet supplied.

Where the factories are owned by the farmers, then, contracts in the sense understood in this country are not in use. Each share carries with it the obligation to supply the factory with a certain minimum quantity of beet, and in Holland, at any rate, questions of date of lifting, regularization of deliveries, prices, &c., come before a committee of shareholders, usually with the managing director of the factory as chairman. This committee has to hold the balance between the most economic working of the factory on the one hand and of the farm on the other, and its decisions are arrived at with this in mind. Farmers, therefore, who, for example, may encounter great difficulties in lifting the roots during a spell of bad weather, are stimulated to overcome them by the knowledge that if the supplies at the factory can be maintained, the factory will work to better advantage, and their returns from that source will be improved, thus compensating them for the additional cost of the operations on the farm.

An inducement to grow a full supply of roots is provided in the Dutch co-operative factories by an arrangement whereby the amortization charges of the factories are divided out per share, whereas the costs of production of sugar are apportioned on the quantity of beet delivered. In this way the share of the factory amortization charges which each farmer is called upon to meet is the same, whether it has to be spread over the minimum quantity of roots that he is bound to supply or over a greater quantity.

In France and Belgium, and in other places where the factories are mostly owned independently apart from the growers, it is usual to find a system of price-negotiating in force between the representatives of the factories on the one hand and the growers on the other. In some cases the resulting contracts are applicable to all the growers in a district, in others separate terms are agreed with each individual grower. It is very seldom that a price is fixed for more than one season at a time.

Whatever arrangement is adopted, it is of course necessary that agreement be arrived at before the sowing time is due, and the two characteristics of the Continental practice are, first, that the market price of sugar is almost invariably taken as the basis of settlement for beet prices, which is probably due to the fact that it is the only factor involved which cannot be influenced by the efficiency of the industry,

and, secondly, that the grower is usually given the option of deciding between accepting a fixed price in the early part of the year and a price which fluctuates with the market value of sugar during the period of the year when the factory has the sugar for sale.

In general terms, the advantages to the farmers who exercise their option in favour of the first of these alternatives are that they obtain a sum of money which they can more or less accurately forecast, and which is paid promptly. In times of depression, when farmers are in need of ready cash, a larger number of them adopt this alternative than in normal times, but it is true to say that the fluctuating price is always the more popular method. It might be inferred that the growers who elect to be paid on a fluctuating price are gaining at the expense of those who are paid outright, but the fact that the number of growers who accept a fixed price bears a very small ratio to the total number of growers would indicate that this is not an important consideration. The reason of the popularity of the fluctuating price is not far to seek when it is considered that any price which is agreed beforehand must be low enough to allow for a possible drop in the value of sugar, and which is therefore necessarily fixed about the lowest probable value of the roots, whereas, when payment is made on the basis of the value at which the sugar actually sells (with due allowance for cost of manufacture, interest on capital, and factory profit), the price is more likely to correspond with the actual value of the beet. In Holland it has only happened three times since 1879 that the fixed price has turned out better for the farmers than the fluctuating price. Moreover, although under a fluctuating price agreement the final settlement of account with the farmers cannot usually take place until the sugar has actually been sold, it is customary to advance to the growers up to 80 per cent. of the probable value of the crop about the middle of November.

Even where the factories are independent of the growers, it is not unusual for the latter to be given a small financial interest in the working of the factory by means of a distribution of a proportion of its profits *pro rata* for beet delivered.

In France it is common to find that the farmer may choose between the dates on which the price of sugar shall be taken as the basis for the calculation of the value of a certain pro-

portion of his crop, a provision which allows for the farmer's predilection for 'doing a deal'.

The following may be taken as typical examples of price-fixing under different circumstances:

A. Co-operative Factories

The starting point is the factory costs, as follows:

<i>Factory costs.</i>	<i>s.</i>	<i>d.</i>
Cost of transporting and handling 1 ton of beet	3	7
Cost of producing raw sugar from 1 ton of beet	4	11
Cost of bagging, loading, and transporting the raw sugar derived from 1 ton of beet	1	4
Cost of repairs, &c., at factory per ton of beet	2	2
General expenses of factory per ton of beet	0	6
Interest on loan capital, interest at fixed rate on farmers' paid-up capital, depreciation of plant, and reserves	2	4
	<u>14</u>	<u>10</u>

The next consideration is the factory receipts, and this depends on the output of refined sugar per ton of beet, and on the price which can be obtained for it.

	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
It may be taken that the average price received by the factory for the sugar was (per cwt.)			15	1
From this must be deducted:				
(a) cost of selling	0	7½		
(b) cost of refining (from the raw sugar state)	2	1	2	8½
			<u>12</u>	<u>4½</u>
Leaving net receipts per cwt. of refined sugar				

Given an output of 294 lb. of refined sugar per ton of beets, this will realize (at the rate of 12s. 4½d. per cwt.) 34s. 2d. In addition to the sugar there will be a sale of pulp, amounting to, say, 11 cwt., worth 3s., and of molasses, say 40 lb., at 2s.

The costs and receipts may therefore be summarized as follows:

<i>Per Ton of Beet</i>				<i>Receipts.</i>			
<i>s. d.</i>				<i>s. d.</i>			
Factory costs	14	10		Sugar	34	2	
Difference between costs				Pulp	3	0	
and receipts	24	4		Molasses	2	0	
	<u>39</u>	<u>2</u>			<u>39</u>	<u>2</u>	

The difference between the cost of manufacturing the ton of beet and the receipts from the products derived from it is 24s. 4d., and this is the sum which the factory can afford to pay on the average for each ton of beet.

Such a statement of account cannot be accurately drawn up until the close of the manufacturing season, but a preliminary estimate enables the factory to make advances to the growers during the campaign, the final adjustment taking place after this statement has been compiled and after one further point has been settled, namely the adjustment of the 24s. 4d. (which is the average price payable for beet of average content) so as to correspond with beet of richer or poorer sugar content.

The above illustration, which represents the practice of co-operative factories, is also applicable to that of some other factories in which, although in actual fact operated by joint-stock companies, the shares are held by the growers of the beet. There is no bargaining, the whole question being one of book-keeping.

In the case of the latter class of factory, however, it frequently occurs that a small proportion of the growers who supply the factory are not shareholders in the factory. The position as between the factory and these growers is similar to that of farmers who supply factories which are not owned by growers, a condition which is considered below.

B. Joint-Stock Companies

The case of a limited liability company differs from that of a co-operative concern in that it must pay dividends to its shareholders apart from the price it pays for the beet. A statement of account analogous to that already discussed is prepared by the factory and is probably used by their representative when bargaining with the farmers, though its contents are not fully disclosed to them. It is necessarily prepared beforehand, and is based on previous experience and probable results, and although similar to the statement of account already discussed, will differ in the important particular that the interest on paid-up capital will not appear as a cost, but will be added to the difference between costs and receipts to form the sum available (a) for payment for beet, and (b) for dividends to shareholders.

It is the necessity for fixing the price, or at any rate the

method by which the price shall be determined, before the growing season begins that introduces the element of uncertainty, and which calls for the use of the results of previous years' workings. Broadly speaking, there are two alternative aims in view under these circumstances. The first resolves itself into fixing a definite price for beet regardless of any subsequent fluctuations in the price of sugar. The following is a typical example of a price fixed in this way which is seen to be similar to the method adopted in this country:

Price fixed regardless of subsequent Fluctuations in Price of Sugar

Determined in March of the Year of Sowing.

30s. per ton of beet containing not less than $16\frac{1}{2}$ per cent. and not more than $17\frac{1}{2}$ per cent. of sugar.

The price to be increased by 1s. 8d. per ton for every 1 per cent. of sugar above $17\frac{1}{2}$ per cent. and decreased by 1s. 8d. per ton for every 1 per cent. of sugar below $16\frac{1}{2}$ per cent.

This method is not common, the more usual system being the second alternative, which aims at fixing the ratio which the price of beet is to bear to the price ruling for sugar during the campaign. In this way, although the factors for calculating the price are fixed in advance, the actual price is not determined until the price of sugar is known.

A hypothetical case of this kind follows. The factory representative knows that in the previous year the average price per 1,000 kg. that his factory paid for beet of average quality represented, say, 75 per cent. of the price for 100 kg. of refined sugar. He also knows that factory costs this year are likely to be higher, and that, therefore, the sum that he can afford to pay to the growers for 1,000 kg. of average roots must bear a lower ratio than 75 per cent. of the average price he will obtain for 100 kg. of sugar. The farmers, on the other hand, may be faced with a probable higher cost of growing, and they will endeavour to secure a higher percentage than 75. The first stage of the bargaining resolves itself around these points. The next stage is begun when, after the ratio which the price of average beet is to bear to the average price of sugar has been agreed, the fact must be taken into account that, whereas the price of sugar will vary, the cost of producing it will be relatively stable. A further discussion then takes place in order to construct a scale by which the ratio of the price of beet to

the price of sugar varies. Such a scale might take the following form:

<i>Where the price of crystallized sugar is</i>	<i>The percentage of the price payable for beet of a sugar content is</i>
200 francs	70 per cent.
240 "	74 "
280 "	78 "
320 "	80 "

This gives the basal rate for beet of average quality. The third stage in the process of price-fixing is then begun, when an adjustment of the basal rate is made in the usual way for beet of higher or lower quality.

This method is common in Belgium.

A modification of this system is found in France. Here the general price-agreement is also reached by a meeting of factory and growers' representatives to cover all contracts in an area (usually one or two counties), and follows the same general lines as those discussed above. The difference, however, arises in that, instead of taking a fixed period during which the price of sugar governs the beet-price, the farmer is given the opportunity of varying this period, so that he may take advantage of any anticipated rise in the price of sugar during the year. A case in which a farmer is given three options of this kind is given below:

Option No. 1. Provided he gives notice before 25 June of his intention to do so, a farmer may notify the factory on any day in July, August, September, or October that he will sell them his beet on the basis of the forward price for sugar ruling on any day in November, December, or January, and on any day in November, December, January, and February that he will sell them his beet on the basis of the spot price for sugar on any day during those four months.

Settlement of account between the farmer and the factory takes place on 15 March.

Option No. 2. Provided he gives notice before 25 October of his intention to do so, a farmer may notify the factory on any day in November, December, January, or February that he will sell them his beet on the basis of the spot price for sugar ruling on any day during those four months.

Settlement of account between the farmer and the factory takes place on 15 March.

Option No. 3. Provided he gives notice before 25 October

of his intention to do so, a farmer may notify the factory on any day in November, December, January, February, March, April, May, or June that he will sell them his beet on the basis of the spot price for sugar ruling on any day during those eight months.

Settlement of account between the farmer and the factory takes place on 15 July.

The general conditions covering these options are:

(a) The farmer when exercising an option must notify the factory by registered letter, and the sugar price actually taken is the third official quotation after the date on which his letter was registered.

(b) The factory only accepts the grower's terms provided it is able to effect the corresponding sale of sugar.

(c) The proportion of each grower's crop which can be sold on these terms is restricted to, say, $\frac{2}{3}$ or $\frac{3}{4}$ of his acreage at a yield of, say, 10 tons per acre.

(d) The farmer must guarantee to supply the quantity of beet involved in each transaction.

(e) The factory has the right to withhold the privilege of the farmer to exercise these options if the fluctuations in the sugar market are so large as to involve excessive covering deposits.

(f) The grower's price is reduced by a small figure to cover the outlay on brokers' fees, &c., incurred by the factory.

(g) The grower's price is also reduced by a progressive amount the later the date chosen by him for selling, to cover cost of storage.

(h) If the grower fails to notify the factory of his choice before the appointed day, he is paid on the average spot price ruling during November, December, January, and February.

Examples of actual contracts are given in Appendix I.

XII. THE EFFECT OF SUGAR BEET ON AGRICULTURE

MANY statements of a general nature are heard from time to time which encourage the belief that the sugar-beet crop has a salutary effect upon the farming industry, and with many of these statements the writers are disposed to agree. The general condition of agriculture in any district is on the whole not difficult to determine by means of observation and inquiry, but it is a very different matter to trace by precise analysis the causes which give rise to that condition. Such an analysis, in fact, can only be properly undertaken where the material for study takes the form of carefully marshalled data rather than of opinions based on general experience.

In the time at their disposal it was impossible for the writers to possess themselves at first hand of any such material, nor was it found that any exact knowledge of the subject—namely, the effect of the crop on the agriculture of the district—was in existence in any country visited, with the exception of one case in Germany. That case must therefore form the basis of the present discussion.

Dr. Fensch and Dr. Sagawe, using as raw material the accounts and records of a great many farms, have definitely set out to study the effect of increasing beet cultivation on the organization and financial aspects of farming in three of the main beet-growing districts of Germany.

Their records appertain to the years immediately preceding the war, a time when the sugar-beet industry was comparatively static, and consist mainly of the financial accounts of some 200 farms.

Many of the results of the analysis of these figures are inconclusive, and need not be considered here, but there are some points which appear to be sufficiently definite to warrant discussion and further study.

The farms have been grouped according to their intensity of beet cultivation, ranging from those farms where no beet is grown up to those where beet occupies some 20 per cent. of the cultivated area. The groups of farms are then compared with each other to see if differences occur according as the beet-growing becomes less or more intense.

The following points emerge:

1. It appears that whatever the degree of beet cultivation, the area devoted to corn and pulse does not vary significantly. The beet crop extends mainly at the expense of other root and fodder crops, while the total acreage devoted to roots (including sugar beet) shows a material increase.

2. As the percentage of land under beet increases, so does the number of cattle carried per 100 acres. In two districts this increase is considerable, and applies both to draught cattle and to purely productive cattle. In the other district there is a distinct decrease of productive cattle, which, however, is not sufficient to counterbalance the increase in draught cattle. In all cases, therefore, there is an increase in cattle, though it is less marked in one district than in the other two.

3. In all cases there is a significant increase of total expenditure as the percentage of land under beet grows.

4. There is a corresponding increase in total income in all cases.

5. Crop yields improve as the sugar-beet acreage increases. Farms in Silesia with 15 to 25 per cent. of their cultivated land under beet show a yield of corn crops 33 per cent. higher than farms where no beet is grown.

6. Profits increase as the intensity of beet cultivation increases.

These are the salient facts in Dr. Fensch's study. There are many reservations which must be made before they can be accepted as being universally applicable, but they are worthy of attention as being the outcome of a statistical treatment of defined facts, from which Dr. Fensch has made every endeavour to eliminate any influence which might invalidate the results. He sums up his findings as follows:

Increased sugar-beet cultivation means increased intensiveness in farm organization and management, increase in gross income, and increase in net profits (per unit of land). Corn harvests are increased, cattle raising is improved, takings per head of cattle other than draught cattle rise. . . . At the same time increased sugar-beet cultivation involves increased risk. In all three districts the farms with a large beet area suffered more from the drought of 1911-12 than the farms with little or no beet.

The first point which comes to mind when considering these findings is the possibility that many of the differences observed, particularly perhaps those which relate to im-

proved crop yields, may be the result of variations in the quality of soil. Although no attempt was made to divide the farms into soil-groups, it is nevertheless possible that intensity of beet cultivation goes along with a more fertile class of soil. In point of fact this was found to be the case in two of the three districts, though, in the opinion of Dr. Fensch, the better soil in one of the districts 'was a result rather than a cause of increased beet-growing'.

Secondly, so far as increases in live stock are concerned, it is a fact that Continental root crops other than beet are on the whole poor as compared with those in this country. It is possible, therefore, that the introduction of beet would actually increase the output of home-grown fodder on Continental farms, whereas in this country the opposite seems to be the case.

Thirdly, an increase in live stock is not in itself necessarily an economic advantage, especially as no inconsiderable portion of this increase refers to draught oxen. So far as this country is concerned, the corresponding increase of live stock in the latter case would be, not of cattle, but of working horses, and these form an item of expense.

Fourthly, the increased expenditure due to beet-growing includes a large increase in the wages bill. It is clear from a study of the Continental practice that this increase is mainly incurred during the summer and early winter months in payment of casual workers. Such expenditure depends upon there being a supply of this class of worker, and it is evident that in its absence a much larger number of permanent hands would be required. These would have to be paid during the less productive months of the year as well as during the periods of beet-work, and it is possible that the increased expenditure under this head would not then be accompanied by so striking an increase of net profits.

Fifthly, the increased expenditure and the heavier stocking undoubtedly involve the use of more capital, to which the increased profits should be related.

XIII. CONCLUDING STATEMENT

THE progress of the sugar-beet industry on the Continent is linked up with many factors. How many of them already exist, or are capable of reproduction, in this country it is difficult to say, as also it is hard to foresee how far the industry can prosper without them.

Certain of these factors may be enumerated here. Probably the most important is all that may be implied in the word *labour*. On the one hand there are the facilities for a ready supply of cheap and efficient casual labour. On the other there is the peasant proprietor with his industrious habits and his frugal standard of living. These conditions do not exist in this country, where labour cannot be obtained on a comparable scale, and it seems inevitable therefore that progress in this country must lie along the lines of increased use of machinery.

Secondly, there is the question of the use of the by-products of the crop. There can be no doubt that the Continental beet crop, which flourishes in districts where other fodder crops are not easily grown, owes its continued existence in no small measure to the full use that is made of the tops and leaves and of the pulp. Without these it is extremely doubtful whether the industry unaided could hold its own against the competition of cane sugar. So important is this feature that every endeavour is being made, by means of drying plants and so on, to increase the value of this side of the business.

Then there is the question of yield. Figures can be adduced to show that increased yields are obtained at a cheaper cost per ton, and that the yields at present obtained in this country are seriously less than those usually found on the Continent. It remains open to doubt, however, whether yields in this country can ever reach the same average level as do foreign yields, for the reason that the areas of soil here which compare for suitability for beet-growing with those on the Continent are extremely limited in extent. That particular combination of clay, lime, and humus which comprises so much of the foreign beet fields can probably be found in this country in very few places.

Further, so far as factory construction is concerned, it is found that the same tendency is noticeable on the Continent

as obtains in this country, namely that where old factories are rebuilt, or where new factories are erected, large factories are preferred. There is the difference, however, that on the Continent this generalization applies to refineries rather than to plants producing raw juice. The economies that are thus effected in the manufacturing process are therefore made in many cases without adding materially to the transport charges which have to be borne by the industry.

For such reasons as these, comparisons between Continental beet-growing and beet-growing in this country are fraught with great difficulty, and may be extremely dangerous. In the opinion of the writers, no Continental practice in relation to the growing of this crop should be adopted, or even recommended, in this country, except after careful trial under British conditions of soil, climate, and, above all, of labour. Attention has been drawn in this report to salient features of Continental practice and experience, and various recommendations have been put forward where it is thought that British beet-growing might benefit from any application of the lessons learnt by Continental growers, but to all these recommendations the above reservation is intended to apply.

On the marketing side, it must probably be admitted that the machinery whereby the Continental grower is assured of obtaining the right price is more adequate than that found in this country. First, by means of district, as opposed to national, agreements, prices can be adjusted to varying local conditions; and secondly, it is the rule rather than the exception for the grower to share in the effects of varying prosperity in the industry, either by means of the application of co-operative principles, or by his being a shareholder in the factory company, or by means of the 'participating' contract. There is an additional advantage in this policy of sharing the interests, in that it tends to make the whole industry hang together.

It is interesting to note, too, that co-operative methods seem to be particularly suited to this industry. So successful have they proved, in fact, that in one country at any rate they now hold a great portion of the field previously occupied by joint-stock enterprise.

APPENDIX I

CONTRACTS

A. The following is a form of contract in use in Belgium between a joint-stock factory company and its growers.

CONTRAT DE BETTERAVES

Campagne 1926-1927

Entre les soussignés 'Société anonyme Sucrierie et Raffinerie' représentée par son administrateur-délégué Monsieurd'une part;

Et Monsieurcultivateur demeurant àd'autre part;

Il a été convenu ce qui suit:

QUANTITÉ. *Article premier.* Le second nommé vend à la première nommée, qui accepte, toutes les betteraves sucrières qu'il cultivera en 1926 sur hectaresares, formant.....de son emblavement en betteraves qu'il livrera en entier et à ses frais à la Sucrierie.....moins.....kilos faisant l'objet d'un contrat précédent passé avec la même société.

Il se réserve les pulpes à provenir de ses betteraves jusqu'à concurrence de 60% du poids net de ses betteraves.

Art. 2. Le fait de ne pas livrer la totalité des betteraves ou d'en livrer d'autres donnera lieu, outre la pleine réparation du préjudice causé, à une amende de deux cents francs par hectare contracté.

Art. 3. La première nommée pourra considérer les livraisons comme terminées lorsque le second nommé aura fourni une quantité moyenne de 40.000 kil. par hectare contracté.

Art. 4. Le vendeur s'oblige à livrer ses betteraves à la date que la première nommée lui indiquera.

Art. 5. La sucrierie se réserve le droit de régler les charriages de betteraves et de pulpes, de les ralentir et de les suspendre momentanément, si elle en voit la nécessité.

Art. 6. Les betteraves non livrées avant la fin des travaux de diffusion ne seront plus acceptées par la première nommée.

QUALITÉ. *Art. 7.* Les betteraves seront de variété *blanche*, saines, non gelées ni altérées, suffisamment nettoyées. Les collets seront coupés droits en dessous de la partie qui aura porté les premières feuilles.

Chaque fourniture comprendra une seule variété de betteraves.

PULPES. *Art. 8.* Si le solde de pulpes, nécessaire pour parfaire les soixante pour cent, est inférieur à une tonne, la sucrierie ne sera pas tenue de les fournir.

Art. 9. Dans aucun cas, la première nommée n'est obligée d'accepter les instructions qui pourraient lui être données par le second

nommé, ou d'ordre et pour compte du second nommé, pour l'envoi de pulpes à des tiers.

RÉCEPTION. *Art. 10.* La société reconnaîtra le poids, la tare et la richesse des betteraves au moment de leur livraison.

Les opérations de pesage, de tarage et les analyses seront effectuées par les employés de la Société dans les locaux de la sucrerie disposés à cet effet.

Le second nommé *pourra exercer tout contrôle qu'il jugera utile* sans cependant pouvoir interrompre ni retarder les opérations de réception.

Les résultats constatés seront définitifs, que le livrancier ou son contrôleur ait été présent ou non.

Les contrôleurs devront être agréés par la première nommée.

Art. 11. Les impositions industrielles qui pourraient être exigées pour dégradations extraordinaires aux chemins par les transports de betteraves et de pulpes du second nommé seront supportées par ce dernier, toutefois la société s'engage à prendre à sa charge les impositions industrielles dans les communes qui ont consenti, avant le commencement de la réception, à les fixer d'après la base d'évaluation établie en 1925 par le service voyer de la province de Liège.

PRIX. *Art. 12.* Le prix de la tonne de betteraves, base seize et demi pour cent de sucre, est établi suivant des pourcentages de cent kg. de sucre cristallisé et dont spécification est donnée par le barème ci-contre.

<i>Prix du sucre cristallisé. Francs.</i>	<i>Proportion à appliquer. Pour cent.</i>	<i>Prix de la tonne de bette- raves 16,5 de richesse Francs.</i>
110	70	77,00
120	70	84,00
130	70	91,00
135	70,5	95,17
140	72	100,80
150	75	112,50
160	78	124,80
170	80	136,00
180	80	144,00
190	80	152,00

Si le prix du sucre cristallisé dépasse 190 fr. la proportion à appliquer reste de 80%.

Le pourcentage à appliquer au cours du sucre pour obtenir le prix de la tonne de betteraves varie donc entre 70 et 80%. Pour les prix du sucre intermédiaires entre 130 et 170 fr. le prix de la betterave se calcule proportionnellement.

Ex. Si le prix du sucre est de 167 fr. 35, donc compris entre 160 et 170 fr., le pourcentage sera

$$78 \text{ plus } \frac{80-78}{10} \times 7,35 \text{ égal } 79,47.$$

La betterave se paie donc $167,35 \times 79,47$ égal 132 fr. 99.

Le prix du sucre cristallisé est la moyenne de côtes journalières (côte nominale au acheteur) faites en bourse d'Anvers ou de Bruxelles.

Du 1^{er} juin au 15 octobre, on prendra la côte du sucre à fournir sur les mois d'octobre, novembre et décembre et à partir du 15 octobre, la côte du sucre disponible. Les côtes s'entendent pour cent kg. de sucre cristallisé en transfert, c'est-à-dire sans droits d'accises.

Si les prix sucre consommation, sans droits d'accises, et sucre exportation diffèrent, c'est la moyenne des deux côtes qui servira à établir le prix de base.

Le vendeur choisit pour la fixation du prix de ses betteraves la période du 1^{er} juin inclus au inclus.

Les degrés de sucre dans la betterave au-dessus et en-dessous de 16,50% se compteront au dixième du prix de base.

La richesse à appliquer à la vente dont question dans le présent contrat est la richesse moyenne de la totalité des betteraves fournies à la sucrerie d'..... par le vendeur.

Art. 13. Ce prix n'est valable que pour autant que les conditions du Gouvernement pour la campagne dernière restent en vigueur pour la campagne 1926.

PAYEMENTS. Art. 14. Les paiements se feront à partir du 15 janvier pour les betteraves vendues suivant le prix de base du 1^{er} juin au 31 décembre 1926 et à partir du 15 avril pour celles vendues suivant le prix de base du 1^{er} juin au 31 mars 1927.

Art. 15. Toute promesse ou convention verbale est nulle et non avenue si la confirmation n'en est faite par écrit.

Fait et signé en double et de bonne foi à le

Pour la sucrerie:

LE CULTIVATEUR.

L'ADMINISTRATEUR DÉLÉGUÉ.

Le second nommé s'engage en outre à fournir:

- (1) La totalité de ses betteraves;
- (2) une partie au moins équivalente en poids pendant les campagnes 1927-28 et 1928-29, et ce aux conditions générales d'achat de la première nommée pour ces campagnes.

N.B.—(1) (2). Prière de biffer la mention inutile.

LE CULTIVATEUR.

B. The following are the general conditions for sale of beet as between a joint-stock factory in France and its growers, in which three options as to price are offered.

CONDITIONS GÉNÉRALES DES ACHATS DE BETTERAVES

Campagne 1926-1927

PRIX. Les 1,000 kg. de betteraves (poids net) à une densité de 7°,5 à 15° de température seront payés en se basant sur le cours du sucre.

Le cours du sucre servant de base au règlement sera la moyenne des côtes mensuelles du sucre blanc n° 3 indigène PARIS, établies par les courtiers assermentés près la Bourse du Commerce de PARIS.

Si le prix du sucre ainsi fixé est égal ou inférieur à 100 francs, la tonne de betteraves sera payée à 60% du prix du sucre.

Si le prix du sucre ainsi fixé est supérieur à 100 francs, le prix de la tonne de betteraves sera établi comme dit ci-dessus pour le prix du sucre à 100 francs, et majoré de 0,70 par franc d'augmentation du prix du sucre au-dessus de 100 francs jusque 200 francs.

Si le prix du sucre ainsi fixé est supérieur à 200 francs, le prix de la tonne de betteraves sera établi comme dit ci-dessus pour le prix du sucre à 200 francs et majoré de 0,80 par franc d'augmentation du prix du sucre au-dessus de 200 francs jusque 250 francs, et majoré de 0,85 par franc d'augmentation du prix du sucre au-dessus de 250 francs.

DENSITÉ. Le prix des betteraves sera augmenté de 0 fr. 80% du prix du sucre par dixième de degré de 7°,6 à 9° et de 0 fr. 40% du prix du sucre par dixième de degré de 9°,1 à 9°,5.

Au-dessous de 7°,5 jusqu'à 7° réfraction de 1 fr. % du prix du sucre, cette réfraction étant limitée à 3 fr. par dixième.

Le prix des betteraves ayant une densité au-dessous de 7° sera fixé de gré à gré, mais la Sucrerie aura la faculté d'en refuser la livraison.

La densité sera constatée au fur et à mesure des livraisons; elle sera basée sur la température du jus à 15°; on se servira, pour éviter de l'yramener, de la table de correction usitée; il ne sera pas tenu compte des centièmes de degré du densimètre.

Le décompte en sera établi à la fin de chaque journée et la densité moyenne appliquée au poids des betteraves livrées chaque jour, comme cela se fait pour les déchets.

La prise d'échantillon du jus aura lieu sur les betteraves ayant servi à établir le déchet, et ce au moyen de la râpe à tambour.

Pour avoir moins de betteraves à râper, on pourra ranger les betteraves par ordre de grosseur en commençant par la plus grosse, en prendre une sur trois, ou quatre sur cinq, ou plus, selon le besoin.

Chaque degré de densité devra correspondre à 2% de sucre du poids de la betterave.

ARRÊT DE PRIX. Les cultivateurs auront la faculté d'arrêter leur prix pour une partie de leur récolte sur les cours des 3 de novembre, cotés en Bourse du commerce de PARIS. Ils devront dans ce cas prévenir la sucrerie, par lettre recommandée, de leur intention, et l'arrêt de prix se fera sur la 3e côte officielle qui suivra la date de la recommandation de leur lettre, si la vente correspondante du sucre peut être réalisée. Sinon, la sucrerie les informera aussitôt et ils auront de nouveaux ordres à donner à la sucrerie dans les mêmes conditions s'ils le jugent bon. La quantité sur laquelle pourra porter cet arrêt de prix sera, à leur volonté, de 10,000 à 15,000 kg. à l'hectare,

étant bien entendu que la livraison de la quantité de betteraves sur laquelle portera cet arrêt de prix est entièrement garantie par les cultivateurs.

La sucrerie se réserve cependant le droit de supprimer cette faculté d'arrêt de prix dans le cas où de grandes variations de cours l'obligeraient au versement de marges trop élevées.

Le prix des betteraves pour lesquelles les cultivateurs auront arrêté leur prix sera diminué de 2 francs pour dédommager la sucrerie des frais de couverture, dépôt, marges, etc., de la Caisse de liquidation de PARIS.

A défaut d'arrêt de prix dans les délais fixés ci-contre, le prix des betteraves sera établi sur la moyenne des côtes officielles journalières suivant le mode qui aura été arrêté par le cultivateur.

GRAINES. Toute la graine nécessaire aux ensemencements sera fournie par la sucrerie, au dépôt de et au prix de 5 fr. 50 le kilogramme, à raison de 20 kg. au moins à l'hectare.

PAIEMENT. Le paiement, déduction faite des fournitures de graines, engrais, avances, ces dernières avec intérêts jusqu'au 1^{er} novembre au taux des avances de la Banque de France, augmenté de un %, aura lieu selon le mode de vente choisi; des acomptes, jusqu'à concurrence de 50% maximum des sommes pouvant rester dues, pourront être demandées à partir de janvier et en prévenant huit jours à l'avance. Les versements de fonds seront faits par chèques, qui seront adressés les jeudis de chaque semaine.

LIVRAISON. Les betteraves devront être livrées en bon état, parfaitement saines et non boutteuses, sans blessures, décolletées à plat à la naissance des premières feuilles et nettoyées autant que possible de leur terre et des radicules.

Il sera fait sur le poids brut des betteraves un déchet représentant la quantité de terre amenée avec elles, les collets, les parties boutteuses, les radicules et les parties avariées par suite de blessures ou de maladies.

Les opérations devront être renouvelées suffisamment pour qu'il y en ait au moins une par dix mille kilos.

Pour les livraisons par tombereaux, la sucrerie se réserve de faire décharger un tombereau entièrement à la main quand elle le jugera nécessaire pour déterminer avec exactitude le fond de terre à ajouter au déchet.

Les betteraves seront de bonne qualité loyale et marchande, celles atteintes de gelées ou de pourriture pourront être refusées.

Les livraisons commenceront dès l'ouverture de la bascule.

Elles devront, pour éviter l'encombrement, être échelonnées par quantités régulières, au fur et à mesure des besoins de l'usine, jusqu'à la date de la fermeture de la bascule, qui sera fixée par la sucrerie.

Les betteraves seront reçues à une grosse bascule située à pour y être pesées et transportées ensuite par les soins du cultivateur à un port ou à une gare près de la dite bascule. Elles

pourront être reçues sur le bord de.....à l'enfoncement du bateau, en présence du cultivateur, et devront être disposées par ses soins en des endroits où il y a assez d'eau pour le chargement complet du bateau. Les cultivateurs devront aussi, dans un intérêt commun, les préserver de toute altération jusqu'au moment de la mise en bateau, où elles seront reçues définitivement.

PULPES. Il sera livré au cultivateur, qui s'engage à ne pas les revendre, et à les employer exclusivement aux besoins de sa ferme, des pulpes dans la proportion de 40% du poids net des betteraves fournies, ces pulpes seront facturées sur la base du dixième du prix de la betterave à 7°,5 départ. La Compagnie ne pouvant être rendue responsable des fermentations naturelles de la pulpe, le cultivateur devra en reconnaître la qualité et la quantité à l'usine, avant le départ des bateaux ou des wagons.

Ces pulpes seront livrables par tiers sur chacun des mois d'octobre, novembre et décembre; sans que le cultivateur puisse exiger en décembre les pulpes non enlevées en octobre et novembre.

Si un cultivateur demande un supplément de pulpes, la sucrerie s'efforcera de lui livrer, le prix du supplément sera fixé par la sucrerie, suivant ses ressources.

OBSERVATIONS. Les empêchements de prendre livraison, tels que: guerre, invasion, grève, incendie ou autres cas de force majeure, ne donneront lieu à aucune indemnité.

Il est expressément convenu qu'en cas de changement à la législation sucrière le prix de base ci-dessus sera modifié en conséquence; notamment le remplacement de l'impôt sur le chiffre d'affaires par une taxe perçue à la production entraînerait une diminution du cours moyen servant de base, égale à l'augmentation des charges qui en résulteraient pour les fabricants de sucre.

Il en serait de même si les conditions du Marché des sucres venaient à être changées ou si les prix de revient de la fabrication venaient à être modifiés par des décrets ou dispositions légales ultérieures (telle que l'application de la loi de huit heures en fabrication).

Si, par suite d'une cause quelconque, les opérations de vente de sucre traitées par la sucrerie, à la Bourse de Commerce de PARIS, avant la récolte, sur la demande du cultivateur, par suite d'arrêts de prix par le cultivateur, venaient à être résiliées, les prix des betteraves qui devaient correspondre à ces quantités ainsi résiliées seraient eux-mêmes annulés. Ces prix seraient alors établis comme s'il n'y avait pas eu d'arrêts de prix, et, comme pour le reste de la récolte, sur la moyenne des côtes officielles journalières du mode de vente choisi.

En cas d'encombrement du port, la Compagnie se réserve le droit de suspendre momentanément les réceptions. En aucun cas, elle ne pourra être tenue de recevoir les betteraves les dimanches et jours de fête.

Toute contestation au sujet de cet accord ou des livraisons qui en seront la conséquence sera jugée en dernier ressort par des arbitres

choisis par les deux parties et départagée au besoin par le Juge de paix du canton de.....

1^{er} MODE: CONDITIONS DES 8 DE JUILLET (faculté d'arrêt de prix jusqu'au 25 juin).

Le cours du sucre servant de base au règlement sera établi, comme il est dit ci-contre, sur le livrable des 3 de novembre, pendant les mois de juillet, août, septembre et octobre, et sur le courant pendant les mois de novembre, décembre, janvier et février; la côte mensuelle de janvier étant diminuée de 2 francs et celle de février de 4 francs pour couvrir les frais d'entrepôt et autres.

Païement. Solde: 15 mars.

2^e MODE: CONDITIONS SUR LES 4 DE NOVEMBRE (faculté d'arrêt de prix jusqu'au 25 octobre).

Le cours du sucre servant de base au règlement sera établi, comme il est dit ci-contre, sur le courant pendant les mois de novembre, décembre, janvier et février.

La côte de janvier étant diminuée de 2 francs et celle de février de 4 francs pour couvrir les frais d'entrepôt et autres.

Païement. Solde: 15 mars.

3^e MODE: CONDITIONS SUR LES 8 DE NOVEMBRE (faculté d'arrêt de prix jusqu'au 25 octobre).

Le cours du sucre servant de base au règlement établi comme il est dit ci-contre sur le courant pendant les mois de novembre, décembre, janvier, février, mars, avril, mai et juin.

La côte de janvier étant diminuée de 2 francs, celle de février de 4 francs, celle de mars de 6 francs, celle d'avril de 8 francs, celle de mai de 9 francs et celle de juin de 10 francs pour couvrir les frais d'entrepôts et autres.

Païement. Solde: 15 juillet.

C. A form of contract between a joint-stock factory company in Germany (shares being held by growers) and the non-shareholder growers who supply it.

An die

ZUCKERFABRIK , G. m. b. H.

Wir Endesunterzeichneten verpflichten uns, für die Zuckerfabrik, G.m.b.H., in, Zuckerrüben zur Lieferung im Herbst 1926 (Campagne 1926-27) unter folgenden Bedingungen anzubauen und restlos an dieselbe abzuliefern:

Die Anlieferung der Rüben geschieht frei..... Für einen Zentner netto reine Rüben zahlt uns die Zuckerfabrik

Rm. 1,00 (Eine Reichsmark)

alsbald nach beendigter Lieferung, und verpflichtet sich ferner, bei günstiger Conjunktur uns eine Nachzahlung zu gewähren.

An Schnitzel wird durch die Zuckerfabrik frei zurückgegeben, entweder

45% Grünschnitzel, oder

4,5% Trockenschnitzel,

wobei im letzteren Falle die Trockenkosten in derselben Höhe wie bei den Gesellschaftern der vorgenannten Zuckerfabrik uns berechnet werden.

Den erforderlichen Rübensamen bis zu 15 Pfd. pro preuss. Morgen liefert die Zuckerfabrik gratis und franko.....

Die Fracht bis zu 15% Schmutz trägt die Zuckerfabrik

APPENDIX 'II

LIST OF REFERENCES TO PUBLICATIONS

- ROEMER, DR. THEODOR. *Handbuch des Zuckerrübenbaus*. Berlin, Paul Parey, 1927.
- REMY, DR. TH. *Zur Lage des Zuckerrübenbaus*. Zweite Auflage. Berlin, Paul Parey, 1925.
- SAILLARD, E. 'Betterave et Sucrerie de Betterave', *Encyclopédie Agricole*. Paris, Baillière et Fils, 1923.
- SAILLARD, E. *Enquête sur la Culture de la Betterave à Sucre en Allemagne, en Autriche-Hongrie et en Belgique par une Commission nommée par le Syndicat des Fabricants de Sucre de France*. Paris, Imprimerie de la Presse, 1910.
- DELILLE, KURT. 'Arbeitsweisen, Arbeitsverfahren und Leistungen beim Zuckerrübenbau im Kreise Marienburg (Regierungsbezirk Hildesheim)', *Landwirtschaftliche Jahrbücher*, LXV. Band (1927), Heft 2. Berlin, Paul Parey.
- AGRICULTURAL TRIBUNAL OF INVESTIGATION:
 (1) Report of Professor D. H. Macgregor, fol. 149.
 (2) Memorandum V. Germany, by Sir William Ashley.
 Final Report, 1924, Cmd. 2145. H.M. Stationery Office.
- FENSCH und SAGAWÉ. *Betriebsverhältnisse der Zuckerrübenwirtschaften*, Teil I: *Vorkriegszeit*. Berlin, Deutscher Schriftenverlag, G.m.b.H., 1924.
- LANDWIRTSCHAFTLICHE BUCHFÜHRUNGSERGEBNISSE. *Untersuchungen zur Lage der Landwirtschaft*. Erster Teil: *Materialien*. Berlin, Mittler und Sohn, 1927.
- ZWAGERMAN, C. *Het Benutzen van Suikerbietenkoppen en Bladeren voor de Veevoeding*. Departement van Landbouw. 'S Gravenhage. Gebrs. J. & H. Van Langenhuisen, 1916.
- DUBOIS, JULES. *Rapport des Planteurs de Betteraves. Commission Nationale instituée par arrêté ministériel du 23 février 1926 pour rechercher les remèdes à apporter à la situation actuelle de la culture de la betterave et de l'industrie sucrière*.
- GARCKE. 'Die Kosten des Anbaues der Zuckerrüben', *Illustrierte Landwirtschaftliche Zeitung*, Year XLV, No. 23, p. 275. Berlin, 1925. Reviewed in the *International Review of the Science and Practice of Agriculture*. Rome (New Series, vol. iv, No. 2, p. 441).
- Annuaire Sycrier*. Paris, Bureaux du Journal des Fabricants de Sucre.
- Official Statistics*
- Verslagen en Mededeelingen van de Directie van den Landbouw*. 'S Gravenhage. Algemeene Landsdrukkerij.
- Statistique Agricole*.
- Répartition et Rendement des Cultures*. Bruxelles, Ministère de l'Agriculture.

PRINTED IN ENGLAND AT THE UNIVERSITY PRESS, OXFORD
BY JOHN JOHNSON PRINTER TO THE UNIVERSITY

231709 Agric. Crops
Author Bridges, Archibald and Dixey, Roger Nicholas B.

Title Sugar beets.

University of Toronto
Library

DO NOT
REMOVE
THE
CARD
FROM
THIS
POCKET

Acme Library Card Pocket
Under Pat. "Ref. Index File"
Made by LIBRARY BUREAU

